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Forthcoming Events.

NOVEMBER 19-26.

Public Works, Roads and Transport Congress and Exhibition at the Royal Agricultural Hall, London.

NOVEMBER 20.

Society of Chemical Industry (Chemical Engineering Group):—Conference on "Solid Smokeless Fuel," at Sheffield.

Junior Institution of Engineers:—Lecturette in London. "De-Hydration of Tar." Paper by G. E. Wills.

Institute of British Foundrymen (Sheffield and District Branch):—Ordinary meeting at Sheffield. "The Influence of Special Elements on Grey Cast Iron." Paper by J. W. Donaldson, B.Sc., A.I.C.

Diesel Engine Users' Association:—Ordinary meeting in London.

NOVEMBER 21.

Institute of British Foundrymen:—Ordinary meeting at Manchester. "An Elementary Study of Foundry Sands." Paper by R. Yeoman.

Yorkshire Colliery Under-Managers' Association:—Lecture at Wakefield, "The Prevention of Colliery Explosions." By Professor Ritson.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Cast Iron Research.

Yesterday the British Cast Iron Research Association held its annual general meeting. For the first time this was followed by luncheon, at which members of the Association had an opportunity of listening to the President and other officers of the Association. A full report of the meeting will appear in next week's issue.

In the meantime we must congratulate the Association and its directors on the results recorded in the fourth annual report presented to the meeting. The membership, the income, and the number of reports issued all show decided increases, and there is an excellent prospect of the Association making up, by June, 1926, for the initial deficiencies. The current year is certainly the most important in the history of the Association, for it concludes the five-year period in which the Association was promised Government support. We understand that the question of further support from the Government will be considered by a committee of experts, which will be appointed by the Government to make an impartial survey of the work of the Association, and we have little doubt that its continuation will be assured.

At the same time it must be borne in mind that only the loyal support from every section of the industry—makers of foundry pig-iron, malleable iron and grey iron—can assure the Association the income which it can wisely spend. The great German Iron Research Institute at Düsseldorf, with its magnificent permanent buildings and staff of some 40 or 50 people, must have an income of about five times that of the C.I.R.A., and every British metallurgist must realise the connection between such institutions and important developments in cast-iron which have emanated from Germany in the last few years. The connection is undoubted. The German Institute is supported by a voluntary tax of a tenth of a penny per ton of output.

From our own observations of what the industry requires and through constant conversations with practical men, we continually make suggestions as to the character of the research required by the industry, and many papers and addresses given to the Institute of British Foundrymen emphasise the necessity for research, and give specific instances of investigations required. Mr. Hurren's paper at the last Conference is an excellent case in point, yet the work required can only be put in hand as and when money is available, and every blast-furnaceman, founder and engineer in the country should see to it that his firm becomes a supporter of the movement.

Technical men themselves know even better than managers and managing directors how slow and tedious research work is, and frequently how disheartening it becomes, and those men who are willing to devote their talents to ensuring further progress deserve all the encouragement that a united industry can give them.

In this column on October 22 we advocated the necessity for foundrymen putting foundry developments and their views on foundry work before engineers, who are, after all, both the designers and the users of castings. We, therefore, learn with pleasure of the forthcoming meeting on December 11 at the Institution of Mechanical Engineers, at which the Director and Consultant of the British Cast Iron Research Association will give papers relating to cast iron, to be followed by a discussion. Such meetings should go far in enabling engineers to state exactly what they want, and will give foundrymen an opportunity of seeing exactly how far these requirements can be met commercially at the present time.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Re Lanz Perlit Iron Process (Patented).

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—During the last few weeks quite a number of the daily papers and technical journals have published letters from correspondents complaining that we are maintaining some sort of secrecy, and are withholding information about the process from possible licensees.

Since the formation of this company in July, 1925, we have done everything possible to make our process public, both through the press, by circularising illustrated brochures, and by writing to the chief engineering works and iron foundries throughout Great Britain and the British Colonies. We do not claim that we have yet reached every works or foundry, but we are doing our best.

We need hardly say that we are most willing and anxious to supply all seriously interested inquirers with complete information, and we are in fact demonstrating the process to many prospective clients in the foundries of both our British and Continental licensees of the process.

We have also engaged as our consulting metallurgist, Mr. H. J. Young, F.I.C., who is available for technical discussions, and who has, during the last six months, read a number of important papers before the leading foundry and metallurgical associations dealing exclusively with the Perlit iron process and the product.

With the object of further publicity we have taken a stand at the forthcoming Shipping, Engineering and Machinery Exhibition, to be held at Olympia from November 23 to December 5. We are showing all kinds of castings made by the various European licensees of the Lanz process, and propose also to demonstrate impact and Brinell tests at the stand. We shall welcome any of your readers who are interested.

Yours, etc.,
THE BRITISH PERLIT IRON CO., LTD.,
JOHN A. SMEETON,
Managing Director.

15, Victoria Street, London, S.W.1.
November 17, 1925.

Perlit Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with considerable interest the publications in your paper on Perlit iron, and in particular the letters signed by "A Foundry Director" and Mr. Smeeton's reply.

I have been a foundry manager and a practical foundryman for many years, and being a member of the Institute of British Foundrymen I take strong exception to the statement of "A Foundry Director" that discussions at our Institute meetings are always cut short by the chairman. I have attended nearly every lecture of the London Branch of the Institute of British Foundrymen for several years, also meetings of the North of England Branches, and by invitation meetings of the Institute of Metals. In no case have I known discussions cut short except through lack of speakers or the limit of time.

I can therefore assure "A Foundry Director" that he would not find our Institute lectures merely scientific essays, as he asserts, but on the other hand they represent practical results of research both by practical foundrymen and working metallurgists of repute whose knowledge and experience is considered by the Institute to be of practical value to their members.

I suggest, therefore, that "A Foundry Director" should attend the London meeting in January next, when I am sure Mr. H. J. Young will be only too pleased to answer any relevant questions on the process and production of Perlit iron.

Now as to Perlit. I have just returned from a ten days' investigation of the process and production of Perlit in the Works of the North Eastern Marine Engineering Company, Limited, at Wallsend-on-Tyne. I have observed carefully every detail of the process from the selection of the charge, the melting and finally the pouring into hot moulds. I have seen the arrangements made for heating the moulds, the mixing of the sand and cores, and every practical detail in connection therewith. I saw very complicated Diesel engine castings of all sizes up to 4½ tons each in weight with intricate cores, cast, trimmed, and machined. I have never seen a surface on any machined casting to compare with them.

I have also seen castings tested, and have made and observed every kind of physical and chemical tests with the object of convincing myself that the claims put forward for "Perlit" are real, practical, and within the scope of all foundries. The result of my investigations is that I can say, without fear of contradiction, that "Perlit" is all and more than is claimed. That any modern foundry with a capable chemist can work the process with very little additional cost for plant. That no such castings have, within my experience, ever been made before by any other process, nor do I believe they can be made to-day by any other process. "Perlit" is, in my opinion, practically a new metal, and should be classed as such, as it cannot be compared with ordinary iron, but is in the same class as cast steel and malleable iron.

It is, I believe, inevitable that all foundries must sooner or later manufacture Perlit castings, as it must eventually be adopted and specified for all classes of engines and machinery, so as to get increased wearing efficiency, combined with reduced weight and greater strength.

I shall be pleased to exchange cards with "A Foundry Director," or if he prefers it, I suggest we both hand our cards to Mr. Young on the occasion of his next lecture in January.

Yours, etc.,
"A FOUNDRY MANAGER."

London, November 18.

I.B.F. Notes.

NEWCASTLE BRANCH.

Re-arrangement of Dates.

The next meeting of the Newcastle Branch of the Institute of British Foundrymen will be held in the Neville Hall, Newcastle-on-Tyne, on Saturday, November 21, instead of on November 28, as previously announced, because of the Shipping, Engineering and Machinery Exhibition which is to be held in London.

Junior Section.

A large party of members of the Newcastle Junior Section and their friends visited the Lemington Glass Works, Scotswood-on-Tyne, by kind invitation of the company, last Saturday.

The visitors were shown round the works by Mr. A. E. Potts, who explained the operations in the manufacture of glass bulbs for electric lamps, etc. The bulbs were of various sizes and shapes, and it was pointed out by the guide that each one, when completed, was subjected to a severe test to ensure that there was not the slightest defect.

Particular interest was shown in the automatic bulb-blowing machine, of which there were two in operation. These very complicated and ingenious machines are supplied with molten glass by a Westlake furnace.

Many of the special bulbs are blown by hand, and the men are kept supplied with glass from three large furnaces, which are working day and night. It was explained that a certain amount of scrap-glass was used with the new glass in each melt.

The department where the moulds for the bulbs are made was also inspected, and the visitors were impressed by the skill which was required to blow some of these moulds, the guide pointing out that the slightest flaw in the operation would result in a defective bulb. It was also mentioned that the interior of the mould must be perfectly smooth, and that each one was heated in an oven before the bulb was blown.

LONDON BRANCH.

MR. H. J. MAYBREY, B.A., has resigned his position on the Branch Council on taking up an appointment at the Kinlockleven Works of the British Aluminium Company. Mr. F. J. Wares, of Peterborough, has been elected to fill the vacancy.

Steel Moulding Sands and their Behaviour under High Temperatures.*

By A. L. Curtis (Chatteris, Cambs.), M.I.Brit.F.

(*Continued from page* 412.)

Method Adopted and Apparatus used for Testing Steel Moulding Sands under High Temperatures.

In describing the methods used and apparatus adopted by the author for examining steel moulding sands, and their behaviour under high temperatures, it may be of interest to show how they originated and were developed. In 1914 and 1915 the author published in THE FOUNDRY TRADE JOURNAL some photomicrographs of moulding sand test-pieces, after exposure to the oxy-coal gas and oxy-acetylene blowpipe flame at varying temperatures. These micrographs were taken from surface illuminated test-pieces after, and not during, exposure to heat. Whilst the method showed fairly accurate and relative results, it gave no indication of what was actually happening to a mineral substance during exposure to the attack of a naked blowpipe flame at high temperatures.

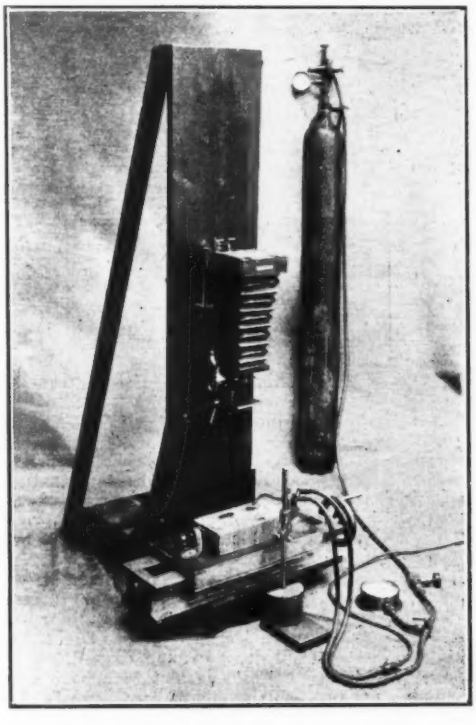

FIG. 20.—HALF-PLATE CAMERA WITH OPTICAL ATTACHMENT.

In 1914 the author was much impressed by a telescopic device invented by Mr. Cornell and developed by Messrs. F. Davidson & Company, the optical apparatus manufacturers, for viewing objects situated at considerable distances from the observer. The principle embodied in this device seemed to open up a new field for metallurgical research if it could be applied to laboratory practice. The author therefore collaborated with Messrs. F. Davidson & Company to formulate ways and means for designing optical apparatus for viewing parts of the interior of industrial furnaces. At first it was thought that the greater the heat interior, the greater would be the prospective field of view, owing to the intense light emitted. Experimental instruments designed on this principle proved that the greater the heat rays the more intense the halation. In other words, the intense light emanating from the mouth of a hot furnace when opened, obscured the object of the experiment. The problem to solve, therefore, was to get sufficiently near to an opening in a prospective furnace with optical apparatus, and bring into the field of view, with the aid of a telescopic attachment, some part of the furnace interior which could be magnified by means of a microscopic objective. Unfortunately, experiments made with varying types of instrument on several kinds of furnaces proved valueless, though many devices were employed for breaking down the intense heat and light rays, without result.

According to R. Sandford Riley,[1] interiors of furnaces have been viewed at the boiler plant of Messrs. Bird & Sons, East Walpole, Mass., U.S.A., high magnification being effected by the use of lens protectors, prepared by enclosing between two lens surfaces a thin layer of gold leaf. Although Mr. Riley's principle was tried by the author in his own research, it was abandoned in favour of more practical methods.

The next step was to try and apply an optical system to a small electric furnace, but beyond getting views of the rugged arcs of the carbons, little advantage could be gained, whilst the gases evolved continually fogged the field of view,

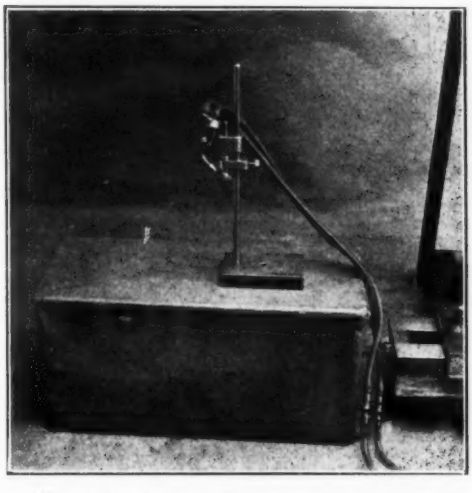

FIG. 21.—OXYGEN BLOWPIPE AND STAND.

and the danger to the lenses used was too great to continue the experiment.

Dr. Schellen[2] however, reproduced in his well-known work the carbon points of the electric light when magnified. The difficulties of applying this principle to practical conditions were, however, too great to surmount. W. R. Mott,[3] of the National Carbon Company, Cleveland, U.S.A., also showed that he could project an enlarged image of certain materials when heated in the positive crater of one of the carbon arcs, but failed to obtain a photomicrograph of such an image, whilst the magnification of the image itself was limited.

Realising that the methods of Schellen and Mott could not be applied to the author's conditions with any great advantage, it was necessary to design fresh apparatus for examining microscopically any mineral substance when heated to a high temperature by using an oxygen blowpipe flame.

The principle of Messrs. F. Davidson & Company's patent microtelescope was therefore adopted, the stand of a microscope being employed to carry on its understage a tube holding a telescope object glass, which would bring into a definite field any brilliantly illuminated object

* Carnegie Scholarship Memoir (Iron and Steel Institute).

[1] Paper read before the American Society of Mechanical Engineers (Fuel Division), December 8, 1921.
[2] Schellen, "Spectrum Analysis," 1872, p. 43.
[3] "Transactions of the American Electrochemical Society," 1917, Vol. XXXI, p. 365.

and project its air image. In order that the projected image should be presented with the utmost crispness of definition, the interior of the tube was fitted with a series of graduated diaphragms.

In place of the body tube common to all microscopes, a wooden front carrying a metal fitting was substituted, the function of which was to form part of the camera used, and that of the metal fitting to carry a microscopic objective. By using a microscopic objective in the metal fitting in this manner, it became a photographic objective, and any air image projected by the telescopic objective became magnified by it.

At first experiments were confined to long-distance observations, separating the telescopic objective from the heated test-piece. Owing to the poor results obtained, however, even with specially constructed lenses, these distances had to be very considerably shortened, each range of distance necessitating the use of fresh lenses.

If any apparatus was to have a practical value in the laboratory it was necessary for one individual completely to control it. This meant that it should be small and of fixed dimensions. As a camera provided with suitable extension was imperative, both camera and microscope carrying telescopic attachment were mounted on a flat board, which in turn was attached to a vertical wooden stand, arrangements being made to provide the necessary adjustments.

Fig. 20 shows a view of the stand with quarter-plate camera and optical apparatus attached, as

FIG. 22 (6A).—SEGER CONE TEST PIECE. EXPOSED 20 SECS. TO 1,200 DEG. C. DISTANCE 24 INS. × 5 DIAS.

made for the author by F. Davidson & Company. This apparatus gave a magnification up to 35 diameters. The half-plate camera and apparatus can be fitted with a projection screen for purposes of demonstration. The optical apparatus was interchangeable with both cameras, the advantage of the larger camera being its greater extension, whereby magnification was increased to approximately 50 diameters with a proportionately larger field.

As both sets of apparatus had to be built up over oxygen blowpipe flame conditions, easily controlled, this called for the greatest care to protect the lenses from damage. After practical demonstration the firm produced, on the designs of the author, special lenses which allowed experimental work to be carried out, at distances of 24 ins. and under, from lens to heated test-piece. Fresh lenses designed from data obtained from the above experiments, and fitted with various protective caps, enabled the above working distances to be ultimately shortened to 7 ins., without danger to the optical system.

The next important step was to design a blowpipe stand, capable of adjustment in any direction, which would carry a blowpipe so that the latter would give a very steady and hot flame. As the acetylene blowpipe, when used with oxygen, was capable of producing the greatest heat, this was first tried. On trial, however, acetylene was found to take too much oxygen, the pressure of which blew out of the field of view small mineral test-pieces during examination. When the pressure of oxygen was lowered the temperature of the flame suffered, so acetylene was abandoned. After a good deal of experimental work, the author approached the British Oxygen Company, London, who constructed an oxygen coal-gas blowpipe to fit in with his designs and stands. This blowpipe was capable of melting platinum wire in a few seconds with 20-lb. pressure of oxygen when using a size of nozzle easily under control by the operator. As it was important that a high temperature be obtained by the use of a small blowpipe flame, this was a great advantage, without the disadvantage of the high oxygen pressure necessary for the acetylene one.

Fig. 21 represents a photograph of the blowpipe stand fitted with blowpipe, specially designed for carrying out this research.

Having found suitable means to provide and control a hot blowpipe flame, the second step was to bring this source of heat into microscopical range, together with any objects for examination during exposure to varying degrees of heat. Primarily, a travelling table capable of moving in a horizontal plane was tried, for bringing test-pieces under the blowpipe flame into the microscopic field of view, but was abandoned in favour of a heavy slide rest attached to a cast-iron lathe bed, on account of the latter's great rigidity. The top of the slide rest was made flat, with the exception of two stops fitted with screws at each end, for holding tightly a well-formed firebrick, on which test-pieces were mounted for examination. The flame of the blowpipe was kept under control by suitable fittings capable of adjustment, checked by a large pressure gauge in the series, and oxygen pressure regulated by an automatic regulator on the cylinder.

The question of test-pieces was a source of some anxiety, as although it was an easy matter to examine or photograph a chip of mineral during

FIG. 23 (6A).—SEGER CONE TEST PIECE. EXPOSED 8 SECS. TO 1,200 DEG. C. DISTANCE 24 INS. × 5 DIAS.

exposure to varying degrees of heat, such a method gave little indication of the temperatures used, and it was difficult to repeat the experiment with any degree of accuracy.

It was therefore decided to employ a standard type of test-piece, in which materials for examination by heat were enclosed. The difficulty was finally overcome by using rectangular fireclay troughs, size $1\frac{3}{8}$ in. × $\frac{7}{8}$ in. × $\frac{1}{4}$ in., in which natural minerals, or materials like steel moulding sands, were embedded. In the case of rocks, these were reduced and screened to one size. A standard trough of the above type provided a definite field of view, which was important when considering the question of temperatures, as unless it was possible to make relative determinations of the different temperatures used, any data obtained were useless. At the commencement of the research the author used a Féry absorption pyrometer, made by the Cambridge Scientific Instrument Company. Owing, however, to the variation in flame of the amyl-acetate lamp used, this was abandoned, though interesting results were obtained with the instrument. The chief objection to it was that the wick of the lamp during use gradually rose, making readings appear too high. Unless the lamp was constantly checked by a second operator using a cathetometer, whose vision was unaffected by the incandescent light from test-pieces, temperatures were liable to be read from 70 to 100 deg. C. too high.

Although many optical instruments were tried, none gave such good results as the above, or the disappearing filament type pyrometer, invented by Drs. Schofield and Griffiths, of the National Physical Laboratory, and made by H. Tinsley & Company. Unfortunately, the size of the heated portion of the test-piece did not lend itself to the latter instrument, which otherwise would have proved most valuable.

During the period of use of an absorption pyrometer, its readings were constantly checked by

rectangular test-pieces prepared from Seger cones, ground in agate. These were then mixed with water into a paste, embedded in fireclay troughs and partly fired. Before mixing, all residues were screened through 100 × 100 mesh sieve. The checking of the pyrometer was carried out by heating a flat Seger cone test-piece in the blowpipe flame until it was observed on the camera screen to flow completely. The instrument was then adjusted on to a test-piece until the oval patch disappeared, and readings were taken, exposures being recorded by a stop-watch. The experiment was then duplicated, using time of exposure and flow of test-piece as a check against pyrometer readings. It was found that with a high flame temperature, using a quarter-plate camera, working magnifications of from 12 to 35 diams. could be obtained; whilst with a half-plate camera, having 24-in. extension, a magnification of 50 diams. was possible. Photomicrographs of incandescent bodies could be taken, with exposures varying from two to ten seconds, at flame temperatures of 1,450 to 1,750 deg. C.

The rectangular fireclay troughs, in which materials for test were embedded, were all made one height, so as to receive the same surface heating effect.

The following photomicrographs will show the development of the apparatus during the period of the research:

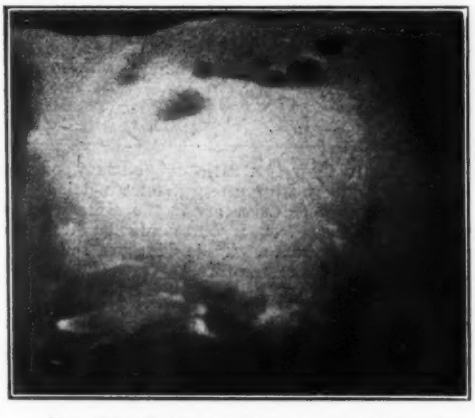

Fig. 24.—Limonite Test Piece, Exposed 15 secs. to 1,500 deg. C. Distance 18½ ins.

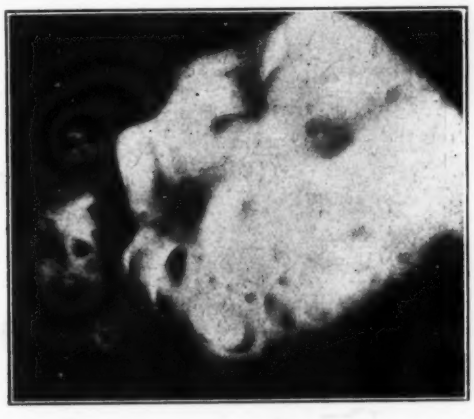

Fig. 25.—Obsidian Test Piece, Exposed 12 secs. to 1,500 deg. C. Distance 18½ ins.

Fig. 22 shows a Seger cone test-piece (No. 6a) with blowpipe flame. Distance from lens to test-piece, 2 ft.; exposure, 20 secs.; temperature, approx. 1,200 deg. C.; microscopic objective, 1 in.; × 5 diams.

Fig. 23 shows a photomicrograph of the same test-piece, taken under the same conditions, with an exposure of 8 secs.; × 5 diams.

Working distances between lens and test-piece were then shortened to 13¼ in., and a ½-in. microscopic objective used.

Fig. 24 shows the mineral limonite, 18½ in. from lens; camera extension, 5 in.; ½-in. micro-objective, plus 4½-in. telescopic objective, after 15 secs. exposure to 1,500 deg. C.

Fig. 25 shows obsidian under the same conditions as Fig. 24. Exposure, 12 secs.

Permeabilities of Steel Moulding Sands.

Owing to the absence of figures in various research workers' papers on the permeabilities of steel moulding sands, it was decided to work out in simple fashion some data relating to the "permeability-to-gas" of those sands referred to in previous parts of this memoir.

According to the recommendations of the Joint Committee on Moulding Sand Research of the American Foundrymen's Association, the term "permeability"[5] is defined as "that physical property of sand which permits the passage of gases." This definition, and the formula accompanying it, were adopted by the author for determining the figures given. The apparatus for carrying out the tests was an adaptation of that recommended by the A.F.A.'s joint committee in 1923, but it was found advisable to make several alterations thereto. The more recent type of apparatus[6] recommended by the American Foundrymen's Association for permeability tests was not used, as the sizes of the air orifices recommended did not appear to permit the testing of very strong natural argillaceous sands.

For calculating the degree of permeability the following formula was employed: Permeability equals cubic centimetres of air forced through the test-piece, multiplied by the height of test-piece in centimetres, divided by the pressure on manometer in grammes, multiplied by the area of face of test-piece in square centimetres, divided by time in minutes. The object of the permeability-to-gas tests was to determine the rate of flow of air per unit pressure through standard test-pieces of those sands previously referred to when compressed at uniform pressures.

The apparatus used differed in size from that recommended by the American Foundrymen's Association, as only 1,000 c.c.s. of air were forced through a 25-gr. sample of sand, in place of 2,000 c.c.s. of air through a test-piece weighing 150 to 200 grs. This alteration was thought necessary as 25-gr. test-pieces were more easily and quickly mixed with water, handled and tested, without any appreciable loss of the water added. With test-pieces varying in weight between 150 to 200 gr., hand-mixing was longer and more tedious, whilst some of the added water became lost before the test was completed.

The author also found that with the original apparatus, when water was fed direct from main to reservoir bottle, and thence to air-displacement bottle, the time to pass 1,000 c.c.s. of water varied. An overhead supply tank was therefore installed, so that the feed to the reservoir bottle could be easily adjusted, the supply tank being fed direct from the main. By this means it was easy to pass 1,000 c.c.s. of water from the reservoir bottle into the air-displacement bottle in a given time, and duplicate results with accuracy. The flow of water through the system was kept constant and frequently checked to keep the rate of flow at 30 sec. per 1,000 c.c.s., the volume being checked after each test by running the used water from the air-displacement bottle into a graduated litre cylinder.

A manometer with a range of 25 c.c.s. was used for recording air pressures, and any test-piece likely to exceed this pressure was mixed with 40 × 50 standard silica sand in order to bring it within the permeability range of a moulding sand. With a test-piece of 25 grs. weight the operation of adding water, mixing 200 times wet in a mortar, besides ramming to a given pressure and testing for permeability, only occupied fifteen minutes with two skilled operators. When larger samples were employed the time taken was longer, and the dangers arising from incomplete mixing

[5] "Report of Joint Committee on Moulding Sand Research, American Foundrymen's Association," June 1, 1924, p. 40.

[6] "Ibid."

or loss of moisture tended to show wider variations between figures arrived at for the same sample.

The American Foundrymen's Association method of ramming sand by using a drop sand-rammer[1] was first tried, but abandoned in favour of a more simple apparatus in which 25 grs. of moistened sand could, after mixing, be compressed in a brass container 3 in. long × 0.995 in. inside dia., to any desired pressure (5 to 75 lbs. per sq. in.). The brass container had then only to be connected up to the permeability apparatus by a rubber tube for the test to be carried out. (See Fig. 26.)

After making numerous determinations it was found that 50 lbs. per sq. in. was a good pressure to ram all test-pieces for conducting permeability tests. Before definitely accepting any figures from permeability tests on moulding sands as accurate, it was decided to check the accuracy of the apparatus.

For this purpose test-pieces prepared from standard silica sand, screened through a 40 × 40 sieve and retained on a 50 × 50 sieve, with an error in size of less than 0.25 per cent., and ball clay of the following analysis:—SiO_2, 50.8; Al_2O_3, 32.49; Fe_2O_3, 1.97; CaO, 1.37; MgO, 0.25; alkalies, 2.50; SO_3, 1.02, and loss on ignition, 9.6 per cent., were prepared in the following proportions:—Silica sand 40 × 50, 20 grs., and ball clay, 5 grs.

1 2 3 4 5

FIG. 26.—MOULDING SAND RAMMING APPARATUS FOR MAKING PERMEABILITY TEST PIECES.

1. Moulding Sand Ramming Instrument; capacity 5 to 75 lbs. per sq. in. 2. Plunger of instrument. 3. Brass container for holding sand and for connecting to permeability apparatus. 4. Plunger for use with container. 5. Sand test piece.

Sixteen batches of standard silica sand and ball clay were each separately weighed out, the ball clay being finally added to the sand, and each batch mixed 100 times dry with a pestle and mortar. To each mix 1.25 c.c. water was added, making a 5 per cent. water content. When the water was being added the batch of sand and clay was cut over 50 times with a horn spatula and then mixed 200 times wet in a mortar. Silica sand having a grain-size between 40 × 40 and 50 × 50 mesh sieve was adopted, because this size of grain plays an important part in the crop of a steel facing sand mixture.

After mixing, each sample was emptied on to greased paper, tipped into the container, rammed at a pressure of 50 lbs. per sq. in., and tested for permeability.

The average of the sixteen test-pieces gave a value for P = 173.8, with an average high error of 7.7 per cent. and an average low error of 7.5 per cent., showing a total variation range of + 7.6 per cent. and − 7.6 per cent. These figures at first sight appeared high as errors, but if all the contributing factors were taken into consideration—that is, variation in distribution of clay substance to sand grains (dry), variation in consistency due to tempering (wet), variation in ramming pressure, variation in water flow through permeability apparatus—it will be understood that as errors the figures were not excessive.

[1] "Report of Joint Committee on Moulding Sand Research, American Foundrymen's Association," June 1, 1924, p. 44.

TABLE I.—*Permeability Tests of Silica Sand. 20 grms. 40 × 50 silica sand: 5 grms. ball clay: 1.25 c.c. water = 5 per cent: mixed 100 times dry, 200 times wet: rammed, 50 lbs. per square inch: air passed, 1,000 c.c.*

Test-Piece No.	Pressure on Manometer.	Time.	Height of Test Piece.	P = Permeability.
		First Batch.		
	Grms.	Secs.	Cm.	
1	6.1	33.0	3.15	182.5
2	6.5	32.5	3.15	174.5
3	6.5	33.0	3.15	171.0
4	6.1	33.0	3.2	185.0
5	6.8	34.0	3.15	160.0
6	6.1	33.0	3.15	182.5
7	6.8	33.0	3.15	163.5
8	7.0	34.0	3.15	154.5
		Second Batch.		
	Grms.	Secs.	Cm.	
9	6.7	33.0	3.15	166.0
10	6.1	33.0	3.15	182.5
11	6.2	33.0	3.15	179.75
12	5.7	34.0	3.15	189.5
13	6.2	33.5	3.15	176.75
14	6.4	33.5	3.1	168.5
15	6.6	34.0	3.15	163.5
16	6.8	33.5	3.15	161.5

In order to show if a ratio existed between permeability and crushing strength of air-dried test-pieces, it was decided to crush the sixteen cylindrical test-pieces of 40 × 50 standard silica sand previously referred to. Table II gives the crushing strength of the samples.

TABLE II.—*Crushing Strength Tests. Test-pieces composed of 20 grms. 40 × 50 silica sand: 5 grms. ball clay: water 1.25 c.c.*

Test-Piece No.	Crushing Strength (Test-Pieces air dried).
	Lbs. per cub. in.
1	22.78
2	24.37
3	20.71
4	24.13
5	26.66
6	20.45
7	24.60
8	24.60
9	24.85
10	24.85
11	27.44
12	26.92
13	25.63
14	29.31
15	28.48
16	25.89
Average	24.93

The author was unable to find from the above figures any definite factor connecting the value for P = permeability with crushing strength; neither could he account for the apparently increased strength of test-pieces in the second batch, as all tests were made under identical conditions.

(To be continued.)

A Good Paint for Wire.—Mix linseed oil with litharge in sufficient quantity to give the required thickness. Add to this one-tenth part of lampblack and boil for about three hours. Always apply in thin coats.

To Clean Paint Brushes when the paint has become hard, dip them in a solution of diluted ammonia. Then rinse with benzine and afterwards wash well with soap and water. Never use potash, as it destroys the hair. Ammoniated varnish removers are now on the market specially for the purpose of washing brushes in this condition.

Practical Points from Recent Researches in Cast Iron.

By B. Rogers.

Cast iron has been the subject of much work recently, both in universities and in private research laboratories. It is probable that foundrymen who are busy have not the time to find what has lately been written of importance on the subject. The Research Bulletins of the British Cast Iron Research Association undoubtedly render a concise statement of the essence of practically all papers read at technical gatherings, and written articles, that have been recently published, bearing upon foundry metallurgy. It is a fact, however, that the number of papers written within the last few years is considerable, and that the subject-matter, of necessity, overlaps, and that different opinions are held by expert metallurgists and moulders upon pressing problems in cast-iron manufacture, many of which have an immediate bearing upon the routine of a moulder's work.

There are a great number of intelligent foundrymen who, lacking a training in chemistry and metallurgy, cannot confidently approach many research papers with hope of gaining sound and reliable information. The B.C.I.R.A. will help them in time. No doubt most foundrymen will be interested, at this stage, in reading what a young metallurgist believes to be points of importance in recent published researches and papers bearing upon the important principles of the metallurgy of cast iron, and, frequently, upon daily practice. It is the writer's hope to add to the knowledge held by foundrymen, notwithstanding his expectation that he cannot altogether escape being a little technical.

It must be borne in mind that in reading a published research the research worker's conclusions are the only safe ones to draw from his work. They are the points in which he has confidence, before placing them before a technical public. He, however, often utters opinions and statements of immense interest in the course of his lecture or writings. An inference may be drawn that he has ideas on certain topics that might some day become more tangible either in his own or other minds, and in consequence, may become future practice.

It is a fact also that certain theories, once hotly disputed, now appear to be placidly accepted by advanced research workers generally. Dr. Hatfield, in his excellent treatise,[1] summed up the position upon important topics up to 1918. Much has been done since to substantiate his summaries of existing knowledge and often to amplify certain sections of knowledge. There are correspondence courses containing information of indisputable practical success, such as McLain's "Semi-steel," but obviously the author can only deal with published researches. The results of these, however, being sound, cannot be entirely different from privately circulated metallurgical knowledge. In addition, they give us an idea as to how workers such as Lanz and Thyssen-Emmel have conducted their researches with claims, not unfounded, to success.

Research is based upon experiment, and it is proposed to deal principally with those writers who have themselves experimented upon practical lines. This number is not so large, and only striking ones are dealt with. Wherever possible, to give confidence, the research worker is quoted literally. Papers recommended as being capable of giving sound information upon study are: (1) "Experiments in Chilled Roll Manufacture";[2] (2) "Cast Iron and Influence of Various Elements";[3] (3) "Formation of Graphite in Cast Iron";[4] (4) "Influence of Manganese on Cast Iron";[5] (5) "Cast Iron in Cupola";[6] (6) "Semi-steel in Cupola";[7] and (7) "Hardness and Machinability."[8]

As a basis for above studies Dr. Hatfield's conclusions are invaluable in his book "Cast Iron in Light of Recent Research."

These articles are especially full of information, the first three giving the authors' conclusions of their own experiments, besides interesting statements. Grennan's experiments establish points on semi-steel melting, whilst Bolton's article contains much for the practical man.

Factors Influencing Total Carbon.

Dr. Hatfield, in his book, "Cast Iron in the Light of Recent Research," makes the following statement based upon experience:—"It will be found that pig-irons of commerce generally contain the eutectic percentage of carbon for the given composition (referring to silicon)." Total carbon decreases with silicon increase, whilst the freezing point of the iron-carbon-eutectic is raised. His figures show total carbon reduced, from 4.3 to 3.4 per cent., with 0.13 and 3.25 per cent. of silicon respectively.

The freezing points of these eutectics increase from 1,138 deg. C., with 4.3 per cent. carbon and 0.13 per cent. silicon, to 1,187 deg. C. with 3.4 per cent. carbon and 3.25 per cent. silicon. In non-technical language. What does this mean? Obviously, that with a given percentage of silicon there is a definite total carbon content and an equally definite melting point.

With a low manganese hematite iron the foundryman might reasonably guess his total carbon content by his silicon. It diminishes the necessity for an analysis for total carbon. According to Stead, with a phosphoric iron, the effect of 1.5 per cent. phosphorus on pig-irons of otherwise similar silicon, sulphur and manganese appears to be to lower the total carbon 0.35 per cent. in 4.1 per cent. Consequently, silicon and phosphorus tend to decrease the total carbon content. More important to the author's mind, however, is Stead's discovery that the lower the temperatures of melting of phosphoric irons under conditions which make possible a resulting high total carbon content, the lower the percentage of carbon present in the irons. That is, under blast-furnace conditions; and it may be equally true of cupola-melted material.

Do we not find it in practice? Are not high temperature pig-irons of high total carbon content? For example, most grey hematite irons contain, in Nos. 1 and 2, 4.0 per cent. total carbon, *e.g.*, West Coast, East Coast, Scotch and Welsh hematites. Also, are not white irons which are made at lower blast-furnace temperatures of a lower total carbon content? The white hematite irons, of total carbon 3.25 per cent., in Welsh, Scotch, East Coast and West Coast irons. Cold-blast irons still further emphasise the point. They are well known to be low in total carbons. Lowmoor, for example, has 3.55 per cent. in the grey, and 2.8 to 3.0 per cent. in the white. High temperatures of the blast furnace favour high silicon, high manganese and low sulphur (the phosphorus being constant). Dr. Hatfield claims high silicon lowers total carbon content in reference to pig-irons of commerce. Although high silicon pig-iron production is favoured by high blast-furnace temperatures, the result is a lower total carbon, according to Dr. Hatfield. He explains "that most high silicon irons contain a high carbon content at the temperature at which they are made (iron being saturated with carbon according to all the rules of the iron-carbon equilibrium diagram for the particular temperature), but it will not hold it on casting." That is to say, the pig-iron will set at its own particular freezing temperature, which is not the same as the temperature of manufacture. *Pig-iron will contain a total carbon content according to its freezing point, or vice versa.* This is determined by silicon, manganese, phosphorus and other elements.

There may have been a high temperature in the blast furnace, but the pig-iron's melting

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[1] "Cast Iron in the Light of Recent Research." Griffin. [2] F.T.J., June 4 and July 13, 1925. [3] F.T.J., March 19 and July 13, 1925. [4] F.T.J., June 19, 1924. [5] F.T.J., June 19, 1924. [6] F.T.J., October 1, 1925. [7] "Foundry," April 15, 1925. [8] "Foundry," September 1, 1925.

point is determined by its own composition, or, strictly speaking, upon the percentages of those elements which influence the solubility of carbon in iron. Pure iron would give an eutectic at 4.23 per cent. carbon, this being the iron alloy with carbon with the lowest melting point. Consequently, pig-irons and cast irons, however made, are alloys of iron with carbon, being eutectics melting points dependent upon varying silicon, manganese and phosphorus contents. Obviously, then, with each fixed percentage of silicon, sulphur, phosphorus and manganese, there is a definite melting point for the pig-iron. This is thought to be the basis for true experimental research on cast iron, *i.e.*, critical points. There is one factor which is outside this reasoning. That is, as Smalley has pointed out recently, the graphitic carbon made at high temperatures of the blast furnaces needs to be re-melted to a similar temperature in the cupola for the graphite formation to be perfectly under control.

It is generally agreed that cast iron as made in the cupola is practically steel with graphite present as a weakening factor. Undoubtedly, it will always be a serious weakening factor as long as it is in lines or planes formed by long flakes. The author inclines to the belief that it is necessary to break up the structure completely by re-melting at the original temperature at which the graphite is formed. In the case of hematites this necessitates a high temperature in the cupola, which involves extra coke. For low phosphorus castings semi-steel is preferable to hematite for that reason.

Before any iron should be melted in the cupola its composition should be known one way or another, preferably by analyses. Substantiating the previous theories and, incidentally, confirming Dr. Stead, there is given in Table I a few more analyses of irons given by Dr. Hatfield in his book. Mottled irons generally have been selected without recourse to picking an iron here and there.

TABLE I.—*The Critical Points of Mottled Irons.*

		S.	P.	Mn.	Si.	T.C.	M. Pt. deg. C.	C. Carbon.
(1)	Mottled West Coast Hematite	0.2	0.03	0.2	0.9	3.5	1,230	2.0
(2)	Mottled East Coast Hematite (Seaton)	0.2	0.05	0.75	1.0	3.5	1,170	1.5
	Also Scotch and Welsh Hematites ..	do.	do.	do.	do.	do.	do.	do.
(3)	Mottled Redbourne Lincs. Iron ..	0.1	1.3	1.1	1.3	3.0	1,270	1.5
(4)	Mottled Derbyshire	0.2	1.5	0.4	1.2	3.0	1,270	1.5
(5)	Mottled Northants (Holwell)	0.2	1.0	0.2	1.25	3.0	1,270	1.5

The melting points are taken from Carpenter and Keeling's work on the thermal phenomena of iron and carbon, because if we are to advance in the metallurgy of cast iron researches, work must be based upon critical point determinations for varying compositions of iron.

The No. 1 iron shows high sulphur, low phosphorus and manganese, whilst the second varies from it only in its manganese content. The total carbon has increased from 3.5 to 4.0 per cent., while the combined carbon drops 0.5 per cent., and the melting point is less by 60 deg. C.

No. 3 iron has, compared with No. 1, a slightly higher silicon, which should reduce the total carbon content. But there is 1 per cent. difference in the manganese. Generally speaking, manganese increases the saturation power of iron for carbon. Yet here is shown a decrease. To the author's mind it is confirmation of Dr. Stead's hypothesis that the increase in phosphorus of from 0.03 to 1.3 per cent. in (1) and (3) respectively has reduced the total carbon by 0.5 per cent. in 3.5 per cent. Nos. 4 and 5 of low manganese content again show this.

As Coe demonstrated, manganese has little influence upon the total carbon. This fact is generally confirmed by commercial pig-irons that total carbon depends on silicon and phosphorus and the temperature, when the silicon is as high as in Coe's experiments, viz., 2.4 per cent. silicon. He found a total carbon of 3.8 per cent. West had the same figure for total carbon in his experiments on the influence of manganese on cast iron with the same silicon, but 0.25 per cent. phosphorus. Also, it confirms Hamasumi, who, experimenting with 1.8 per cent. silicon alloys, found that manganese up to 3.15 per cent. gave good machinability, increased the Brinell hardness (actually from 191 to 260), increased the tensile strength from 17 to 26 tons per sq. in. The total carbon was 2.7 to 2.9 per cent., and combined carbon 0.7 to 1.0 per cent. That is to say, with 2.0 per cent. silicon and a very high manganese he obtained only 3 per cent. total carbon. It should be pointed out, however, that he melted white iron and steel. Incidentally, this amount of manganese did not affect the graphite percentage with 2 per cent. silicon. It improved the fluidity, did not make it brittle, reduced dissolution of gases, and was capable of changing the structure of the cast iron from pearlitic to sorbitic and austenitic states with increasing percentages of manganese. Hamasumi says: "It has been the custom for years to say that a high manganese cast iron is hard to machine and is accompanied by a large shrinkage. That may be true when cast iron is chilled white or when austenitic, due to high manganese, but in the presence of 2 per cent. silicon and with 2 to 3 per cent. manganese the anxiety on this account disappears."

Again, with regard to the structure, the iron being pearlitic whilst the graphite was in the "whirl" form in all the alloys of 0.5 per cent. manganese and over, it appears to be at least one method of producing high-class castings.

All Hamasumi's alloys contained 3.0 per cent. total carbon, with 1.8 per cent. silicon associated with varying percentages of manganese. Manganese did not influence total carbon content with 2 per cent. silicon. Thus Coe's experiments and West's were confirmed. The formula TC + Si = 4.5 is thus also confirmed for 2 per cent. silicon alloys and over. Manganese is thus brought into its own and hesitation in using it in presence of 2 per cent. silicon should now disappear.

It has been axiomatic that silicon should be regulated according to section of castings being made. Manganese should be higher than 0.5 per cent., and high manganese should not cause worry in the presence of 2 per cent. silicon. Incidentally, high manganese is not economical after it has acted as a "scavenger," which will be obtained equally by lower manganese (above 0.65 per cent.).

Silicon, therefore, stands out as the guide to good practice. Phosphoric irons are required for intricate or thin work. Recent researches have only confirmed these points. The silicon figure given by the old empiric formula is the maximum amount that should be used.

Casting Temperature.

Hatfield insists that temperature causes irregularities in the combined carbon, having the effect of assisting super-cooling—that is, it was raised from 0.3 to 0.8 per cent. in one case in Coe's experiments with 2.4 per cent. silicon. This is an analogy to Stead's findings that the lower the temperature of melting of iron-carbon-phosphorus-alloys combined below blast furnace temperatures, the lower the carbon percentages present. This shows that temperatures should be kept constant if a consistent product is to be obtained, when using the same mixture. This also implies the desirability of a pyrometer to control casting temperatures.

Beeny, when dealing with the "Rates of Cooling of Cast Iron," recently concluded that:—

"From a practical point of view the best results are obtained with the *lowest possible silicon and total carbon contents that can be safely depended upon to give a non-chilling effect in the smallest important section of the casting.*" Undoubtedly he sums it up comprehensively and correctly.

The factors which are capable of being kept under better control are thus, casting temperature (preferably constant for the same mixture) and cooling rate, likewise to constant for a constant mixture. Only variations in section then occur to influence the success of the operation.

It is upon these lines that foundrymen need to work. The Lanz process claims to have succeeded in producing consistent results. They have done so by regulating the rate of cooling to a fixed composition of charge, casting temperature being under control and elements, especially silicon, according to section.

They have succeeded by experimenting. McLain's semi-steel was the result of experiments. The Thyssen-Emmel process is the result of experiments. Turner's classical work on iron and silicon was experimental. Theory is often guesswork. An experiment proves or disproves it, when practicable. Experiments have been published, to which reference has been made to show, for instance, that high manganese is not detrimental to castings with 2 per cent. silicon. As many reliable workers confirm the point out of date opinions should be discarded.

Allison has published experimental results showing that 0.36 per cent. manganese is a critical point with 0.7 per cent. silicon for chilling purposes, and that it varies with silicon percentage. Up to 0.8 per cent. manganese is the maximum, according to this worker, that can be used to aid in removing chill which is not entirely removed by silicon. This refers to work at 0.8 per cent. silicon showing that manganese can be a softener when it is 0.8 per cent. associated with 0.8 per cent. silicon. Keep confirms this statement.

Northcott said, in the article referred to previously: "It is, of course, possible that new alloys of high manganese and high silicon might be even more useful than the compositions hitherto employed." Again Hamasumi says 2.0 per cent. silicon in green-sand moulds ought to give good results. These disclose a useful basis for further experiments. Moreover, Emmel says "composition of charge will probably be future method for control of manufacture in cast iron in the cupola."

The Lanz process involves control of cooling artificially by heating the moulds to varying temperatures for varying compositions of the iron. The author is of opinion that, as Hamasumi states, and Emmel confirms, there is a particular composition which under pyrometrically controlled casting, and properly conducted mixing and melting, will render a useful product. If 2.0 per cent. silicon and green sand were experimented with, with varying sections on a product, that would not involve much expense, and in which, at present, widely different mixtures are being used in different foundries, much might be learned. Moreover, although high-manganese irons or ferro-manganese are expensive, it is thought that developments will occur on the lines of silicon and manganese cast iron alloys of higher percentages than normally used. High percentages of manganese (2.75) have been used in thin sections with excellent results in America. Steel was used and semi-steel is a good product, especially for medium and heavy castings. Being stronger than ordinary grey iron, it allows of a saving in costs by means of reduced weight of sections of castings.

Like all good irons, it needs careful silicon control in reference to section, and moreover will have to be properly melted. Undoubtedly there is room for a great improvement in cupola practice in the average foundry.

Before a founder should expect to make semi-steel properly, he should be able to produce good grey-iron castings. Semi-steel needs careful attention to certain points in cupola working. Grennan has shown in a recent issue of THE FOUNDRY TRADE JOURNAL, however, that tuyere area is not important. The same writer has also shown that steel absorbs 1.5 per cent. carbon before melting, which lowers its melting point. It does not then behave as steel, but practically as a high carbon alloy—in fact, approximately, as a cast iron. It is not known definitely whether the steel absorbs carbon *after melting*, though there is little against that view. Anthracite is regularly used for carbonising liquid steel.

Carburising will *depend* upon percentage of composition. There are also other factors to be regarded as important in semi-steel melting. When made with laboratory control over composition, it does, after a time, respond to control better than cast iron. Semi-steel is more sensitive to conditions than grey iron. It does, however, require more care initially, to achieve success.

Contraction Defects.*

BY R. DE FLEURY.

Readers are already fairly familiar with Mon. de Fleury's work, especially in respect to the metallurgy of light alloys. His Paper before the Liège Congress opened by stating that the foundry was capable of reproducing a considerable number of defects of various kinds. These were difficult to study because the properties of metals were dependent upon eight variables. They were enumerated as follows: Speed of cooling; viscosity; solidification period; occluded gas; solidification contraction; coefficient of expansion; circumstances influencing the fluidity; and heat conductivity. As an example M. de Fleury discussed the solidification period as a contributory cause of various sorts of piping.

He then detailed both the case of eutectic alloys, which have no solidification period, and the non-eutectiferous alloys which exhibit this phenomenon. Eutectics, such as alpax, should in principle show a cavity resulting from central piping, the amount of which depends upon the relationship between the commencement of teeming the liquid and the starting of the cooling due to the mould walls. At least this is so where the latent heat of solidification is low. The piping can be split up into several cavities, *ad infinitum*, until "micro-piping" is realised. For some seconds there in reality are two solidifications, one of spongy type being more or less cellular, forming a "macro-piping" or, generally speaking, "intercrystalline looseness."

Referring to actual piping, M. de Fleury placed them into two categories—simple and complex. The first relate to eutectic alloys, and to obviate them it is necessary to realise the following *desideratum*, the surfaces of successive strata of solidification in communication ought always, up to the very end, leave the part still liquid in communication with the exterior fluid mass of the casting. This can be accomplished by reheating (by means of large risers) or by rapid cooling (by the use of chills or other cooling methods or slow teeming).

For complex piping, to be associated with non-eutectiferous alloys, M. de Fleury dealt successively with those complicated by cracks and those accompanied by blowholes and pin holes, and laid special emphasis on those which appear at regular intervals in the foundry. In passing some space was devoted to grey cast iron which shows but little "piping."

In conclusion, the author said that normal foundry defects had more complex causes that was indicated by a mere analysis of the metal, mould construction, or personal skill.

Iron-Works Products in West-End Window Display.

We notice that the showroom of the Staveley Coal & Iron Company, Limited, at Crown House, Kingsway, is now open, and shows a comprehensive range of chemicals coal, pig-iron, cast-iron pipes, tarred slag, etc. It would be interesting to have confirmed our belief that this is the first time in history that a shop window in the West End of London has ever been exclusively devoted to the showing of the products of an iron works.

* Extract of a Paper read before the Liège Congress.

Modern 125-Ton Open-Hearth Plant.

Considerable interest attaches to the installation of four 125-ton stationary open-hearth furnaces, the first unit of an ultimate twelve-furnace plant, recently put in operation at the Fairfield works of the Tennessee Coal, Iron & Railroad Company, at Fairfield, Ala., in the Birmingham district, U.S.A. The furnaces use the pig and scrap process. Generous space is provided as indicated by the accompanying illustration, the building being 450 ft. long with both pouring and charging sides 76 ft. 7 in. centre to centre of columns and with a 37-ft. lean-to on the charging side, to house the waste-heat boilers.

On the pouring side of the building on a level with the cage floor of the 200-ton ladle crane is an escape platform the full length of the building by which the operator can quickly gain the outside of the building through a series of doors. The 200-ton 67-ft. span ladle crane is supplemented by 40- and 15-ton auxiliaries, while the charging floor is served by a 125-ton, 67-ft. ladle crane with a 40-ton auxiliary and by a 12-ton low-type charging machine. Each furnace has a 6-ton jib crane for spout handling, etc.

The charging-side building extends 50 ft. beyond the floor to enable the 125-ton crane to pick up the 70-ton hot-metal ladles coming from the blast furnaces and charge them directly into the open-hearth furnaces. The furnaces are built

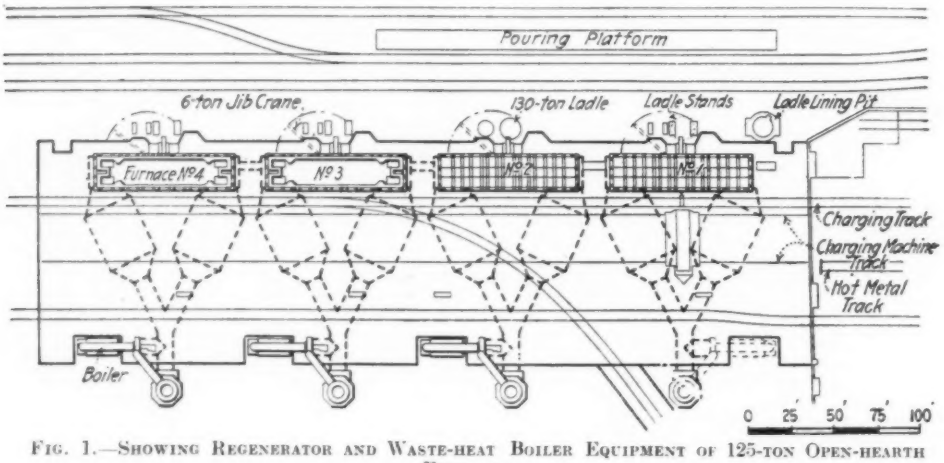

FIG. 1.—SHOWING REGENERATOR AND WASTE-HEAT BOILER EQUIPMENT OF 125-TON OPEN-HEARTH FURNACES.

to use either tar or by-product gas, or both fuels at the same time. Oil can be used instead of tar by a slight change in the burner orifice, if desired. The furnaces have hearths 15 ft. 3 in. by 48 ft. and are 18 ft. 3 in. by 76 ft. 6 in. outside of brickwork. The binders are of heavy steel construction with 6½-in. × 15-in. slab buck-stays which are water-cooled. Slag-line coolers are provided on both front and back walls. Each furnace is provided with five water-cooled doors and frames. The doors are operated by five 2-ton electric hoists. The furnace roof is 13½ in. thick with 18-in. ribs throughout. The slag pockets are large with air-cooled bottoms.

The tar and coke-oven gas burners are combined in one water-cooled unit, and both tar and gas are reversed by two steam cylinders, one at each end of the furnace, and operated by two 3-way valves. By means of bent slotted levers the atomising steam is turned on just before the tar and turned off just after the tar is shut off. The complete fuel reversal system is above the charging floor. An interesting feature of this open-hearth plant, which is described in "The Iron Age," is the arrangement of regenerator chambers (Fig. 1), built on converging angles so that the regenerators and stack flues form a Y, thus giving the most direct route to the stack. The regenerator chambers are steel lined and insulated. The stacks are of radial brick type, 7 ft. inside and 200 ft. high, with waste-heat boiler connection. Three furnaces are equipped with heavy marine-type, single-pass, horizontal fire-tube boilers of about 500 rated horsepower.

Company Meetings.

A. J. Stevens & Company (1914), Limited.—MR. E. E. LAMB, presiding at the 12th annual meeting of this company, said that, looking at the list of assets, the cash stood at £38,400. This was below the amount of the previous year, but the difference was more than made up by the next four items. Sundry debtors had increased from £68,943 to £84,297, stock-in-trade from £135,814 to £211,438, machinery, etc., from £78,460 to £114,007, and freehold land and buildings from £87,817 to £125,312. The stock-in-trade figures might seem large, but he (the chairman) could say with some knowledge that the board would be only too happy if they were twice that total. The machinery increase had been on account of the expansion of the business in all directions. The augmentation of some £38,000 in land and buildings was due to the new range of shopping at Graiseley and to the buildings at Walsall Street, which latter now almost entirely covered the land available there.

Aluminium Corporation, Limited.—Presiding at the fifteenth annual meeting of the Aluminium Corporation, Limited, MR. K. M. CLARK pointed out that £269,556 had been expended during the past year on the acquisition of lands and development of power and plant. Proceeding, he said that a year ago he informed them that the work on the new pipe line was approaching completion, and that the directors expected that the company would obtain during the year now under review the benefit of a considerably increased power installation. Within two months, however, of his making that statement they were faced with a very serious crisis in the company's history. The new and large pipe line which they had then just installed was put under test about November 17, and for about ten days apparently gave satisfaction, but unfortunately on November 27 it became dislocated and the entire installation was rendered useless. It was necessary practically to rebuild the pipe-line, and it was only during the last month that they had been able to bring this pipe-line into active operation again. The sales of metal during the past year were at least 33⅓ per cent. in excess of the previous year's figures, and the sales of energy showed an increase of about 24 per cent. Prices continued satisfactory, while the demand for their products was in excess of their ability to supply. They had, of course, continued their close association with the North Wales Power Company, and were speedily increasing the quantity of energy supplied to that company, although their transmission system had not yet reached the London, Midland and Scottish Railway Company's works at Crewe. Just before this latest calamity they had more furnaces at work than ever before in the company's history.

THE POSITION of the British malleable cast iron trade was reviewed by Dr. P. Longmuir, before the members of the Sheffield Foundry Trade Technical Society on Tuesday. Mr. R. H. Bowen presided.

IN A LECTURE at the Sheffield Metallurgical Association's rooms, on Tuesday, by Mr. W. J. Rees, on the selection and use of steel works refractories, special reference was made to German silica bricks. At the present time the German bricks were being used in the Sheffield district, yet it could be definitely proved that at least half-a-dozen firms in England were producing silica bricks for any purpose, which in all respects equalled the silica bricks made in Germany.

The Selling of Castings.—XXII.

BY VOYAGEUR.

Mailing Lists.

The first point to be considered in arranging a mailing list of potential customers for castings is the classification of the names it contains. Shall this be industrial, geographical, alphabetical, or what? There are certain advantages attached to each; but, on the whole, the alphabetical list will be found the best for quick reference. It saves a good deal of time and energy when it is necessary to hunt for a particular name in order either to check or alter it. One has but one place in which to look. On the other hand, if one wishes to circularise a particular industrial group, or a particular district, the alphabetical list is useless. The best plan that the writer knows is that adopted by a large firm of steel founders, whose arrangement combines the facility of reference of the ordinary alphabetical list with the group advantages of the other systems of classification.

In this scheme, the list is grouped first in travellers' districts and overseas countries. The names in each separate group are in alphabetical order. The advantage of this is that, if the list for a particular district needs revision, as it is bound to do from time to time, the list for his district can be sent as it stands direct to the traveller or agent for that district. The addresses are carried on metal stencils, and kept in drawers ready for use in an addressing machine. The stencils themselves are slipped into metal frames, which also carry the address itself printed on a slip of paper, so that the operator of the machine can pick out any address required or not required. The plan is next adopted of marking these slips in such a way that every possible classification of the names and addresses is represented, without in any way altering the alphabetical and geographical groupings. This is done by giving to each sub-classification a characteristic mark or symbol, which enables the operator of the addressing machine to pick it out from the others as they follow one another in a steady stream through the machine. If it is desired, for example, to circularise all collieries, the operator puts a drawer full of stencils into the machine, and watches for those bearing the required distinguishing mark. These she allows to print on the envelopes or wrappers. The others she prevents from printing by the simple action of pulling a lever. At the end, she has run off envelopes or wrappers for all the collieries, without having to pick their stencils out by hand from the hundreds of other, as would otherwise have been necessary.

To show how this system of sub-classification can be carried out simply, the following hypothetical examples of stencil markings are given:—

Collieries: Green horizontal line across slip.
Railways: Green vertical line across slip.
Steamship Companies: Green diagonal line across slip.
Engineers: Red horizontal line.
Automobile Manufacturers: Red vertical line.
Shipbuilders: Red diagonal line.

It may be argued that, while this system is applicable without difficulty when the founder possesses a machine for addressing his envelopes, it breaks down when these have to be typewritten or hand-written in the ordinary way. This is not so, because the same scheme, adapted, can be made to serve in the latter instance also. The way it is done then is to number each address consecutively, beginning with the first group. The addresses will be on typewritten sheets. The first will be No. 1 and the last, say, 1,000. The names will then be gone through, and an ordinary index book will be taken. In this book collieries, cement makers, etc., will all be found under C, shipbuilders under S, and so on. Every colliery, for example, will have its address number recorded under "Collieries" in this book. The book will then have an appearance something like this:—

Collieries, 1-23-45-67-78-89-234-345-567 (et seq.).
Cement Makers, 7-34-567-777-789-799-801 (et seq.).

When wishing to circularise collieries, the operator will simply take the book and the lists, and rapidly type out each address corresponding in number to those given under the heading of "Collieries" in the book.

One advantage of this system is that there is no limit to the number of classifications that may be made. For example, in addition to classifying addresses under the industry they represent, they may be graded according to size, or according to capital, or according to number of hands employed, or according to the use they make of a particular kind of casting, and so forth. Obviously, it is much simpler and easier to have these ready classified than to have to go through a drawer or a list, and have them all picked out by hand. Again, there is the superior speed with which circulars can be sent out by this method. If a topical event that offers an opportunity for circularising takes place, the circulars can often be got out opportunely the same day, whereas if the addresses had to be picked out by hand, so much time might be lost, and some mailing lists run to more than ten thousand names—in sorting out the right names to circularise, that the timeliness of the circular might have vanished when the task was completed.

Having arranged the list efficiently, there next follows the laborious, day-to-day task of keeping it up to date and effective. A list that is obsolete is useless. Salesmen must help by revising the list of names in their districts, every year at least, if not oftener. Every wrong address or wrong name on a circular means waste of postage and time. The personal columns of trade journals, etc., will contain many intimations of changes in personnel or address, of alterations in style, of changes of occupation, etc. They must, therefore, be closely followed. One firm of founders adopts the plan of sending out, every now and then, a reply card asking its potential customers to indicate on it any change in address or style.

Letters returned by the postal authorities will lead to the removal of obsolete names, or to the discovery of wrong addresses. Another useful way of finding both new names and alterations of address is to study the list of members and their addresses issued by different engineering and foremen's societies year by year. A good plan is for the sales manager to have his own name on the mailing list, so that he receives a copy of every circular sent out. The advantage of this is that it enables him to see the condition of the circulars as they reach the addressee, to check the efficiency of the operator of the addressing machine, and so forth.

But when all is said and done, a good mailing list well kept is useless if the material sent out to the names on it is poor or inefficient. The next article of this series will, therefore, discuss sales letters, one of the most important forms of selling.

Iron and Steel in October.

The production of pig-iron in October amounted to 473,700 tons, compared with 448,700 tons in September and 586,400 tons in October, 1924. There were 136 furnaces in blast at the end of the month, a net increase of seven compared with the number in blast at the beginning of the month, 10 having been put into blast and three having been damped down or blown out.

The production includes 138,000 tons of hematite, 174,700 tons of basic, 119,600 tons of foundry and 17,600 tons of forge pig-iron. The production of steel ingots and castings amounted to 647,100 tons, compared with 640,100 tons in September and 678,500 tons in October, 1924.

Non-Dusty Concrete.—Mix together 1 part cement and 2½ parts clean granite chips. This will make a good floor, which can be washed down and will be practically dustproof if well looked after.

Welding Fluxes.—Steel: 1 part of sal ammoniac and 10 parts of borax. Iron: Resin, borax, tinned iron. Brass: Sal ammoniac. Copper: Sal ammoniac. Zinc: Chloride of zinc. Lead: Tallow of resin. Lead pipes: Resin and sweet oil. The above are, of course, quite applicable for soldering.

Brinell Hardness and Tensile Strength of Cast-Iron.*

MR. J. G. PEARCE, B.Sc. (Director and Secretary of the British Cast Iron Research Association), writing in the October Bulletin of the Association, emphasises the importance of the relation between Brinell hardness and tensile strength of cast iron, pointing out that the tensile test, while generally accepted, involves a certain amount of time and labour before it can be obtained, whereas the hardness test is simple, direct and could often be carried out on the actual casting. Attempts have been made (he continues) to relate the modulus of rupture (transverse test) and the tensile test, and it is generally accepted that the modulus of rupture is 1.4 to 1.8 times the tensile strength, but the ratio is not definite enough to have resulted in one test superseding the other. On the contrary, the two tests are called for in even the latest specifications, and if no direct relationship is possible between the transverse, which may be regarded as a combined compressive and tensile test, and the tensile, it is scarcely to be expected that any can be found between the tensile and any hardness test, Brinell or other. The general uncertainty of these relationships is indicated by the fact that until recently Continental metallurgists have taken transverse strength as twice the tensile strength.

The Brinell test is generally considered an unsuitable test for a heterogeneous and brittle material such as cast iron. In so far as cast iron consists often of a relatively soft matrix of pearlite with hard patches of phosphide eutectic, it may be likened to a bearing metal and the hardness will clearly depend on whether the ball meets matrix or hard spot. As the distribution of hard spots is irregular the results even from the same piece of iron will be erratic. The presence of graphite further complicates matters. Broadly, however, Brinell hardness will be governed by the phosphide eutectic. The tensile strength will, in the main, be governed by the size and distribution of the graphite, and hence an invariable relation can scarcely be expected.

In endeavouring to establish a formula for converting hardness values to tensile strength, Portevin suggested

$$K_z = 0.2H - 13$$

where H is the hardness figure (Brinell) and K_z is the tensile strength in kilogrammes per sq. mm. Converting K_z into tons per sq. in.—

$$K_z = 0.635\,(0.2H - 13) = 0.127H - 8.25;\ \text{or}$$

$$\text{say} = \frac{H}{8} - 8.25.$$

Hence an ordinary 12-ton iron would give a Brinell hardness of $12 = \frac{H}{8} - 8.25$ or $\frac{H}{8} = 20.25$, whence H = 162. A hardness of 200 gives a tensile of 25 – 8.25 = 16.75 tons per sq. in. according to this formula.

Schuz, on the other hand, proposed the formula—

$$K_z = \frac{H - 40}{6}$$ where K_z is in Kg./sq. mm.

Converting to tons per sq. in.

$$K_z = \frac{0.635H - 25.4}{6} = 0.106H - 4.23;\ \text{or}$$

$$\text{say } K_z = \frac{H}{10} - 4.25.$$

Hence, according to this formula, an ordinary 12-ton iron would give a Brinell hardness of $12 = \frac{H}{10} - 4.25$ or $\frac{H}{10} = 16.25$, whence H = 162.5 while a hardness of 200 gives a tensile of 20 – 4.25 = 15.75 tons per sq. in. The two formulæ, therefore, give fairly concordant results, Portevin giving slightly lower figures than Schuz, for hardness from tensile strength. For the reverse operation of calculating U.T.S. from hardness, Schuz gives the lower figure.

In order to ascertain the utility of the Continental formulæ for British irons the Brinell and tensile figures are given herewith for different diameter fingers on a casting made in different mixtures but to the same pattern and under similar conditions. The compression values are given in one case as well to show whether there is any relationship with compression:—

Finger (square side given).	Actual Brinell skin value	Actual comp. str. Tons/ sq. in.	Actual tensile. Tons/ sq. in.	Calculated tensile. Tons/ sq. in. Portevin.	Calculated tensile. Tons/ sq. in. Schuz.
CASTING W2					
½ in. ..	388	—	13.5	40.25	34.55
1 in. ..	235	—	12.9	21.12	19.25
1½ in. ..	229	—	10.84	20.37	18.65
2 in. ..	217	—	10.44	18.87	17.45
3 in. ..	197	—	5.5	16.37	15.45
CASTING A.					
½ in. ..	204	66.5	12.25	17.25	16.15
1 in. ..	229	57.2	12.60	20.37	18.65
1½ in. ..	188	53.36	10.60	15.25	14.55
2 in. ..	216	45.36	10.65	18.75	17.35
3 in. ..	161	41.76	9.30	11.85	11.85

It will be noted from the foregoing results, given on two samples of irons of excellent engineering quality:—.

(1) That no concordant results are obtained by plotting either actual tensile or actual compression against actual Brinell values. It can be said that as the thickness of finger increases, the hardness decreases and tensile and compression decrease, but there is no definite relationship connecting the two. Examination of figures from many other castings confirms this view. (2) That the formulæ proposed by Portevin and Schuz for cast iron give calculated tensile values from the Brinell figure 1.5 to 3 times as great as the actual tensile value, so that they do not appear to be of any service whatever.

The relationship is being further investigated with reference to Brinell variation across a thick section and to structural composition, but the above indicates that no rule sufficiently simple to use in a machine shop is likely to be discovered in the near future, particularly for the purpose of determining rate of removal of metal by a cutting tool, as this involves a further relationship between Brinell hardness and machinability yet to be established.

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Legal.

Darlington Forge *v.* Attorney-General.

The Lord Chancellor and Lords Atkinson, Buckmaster, Carson and Blanesburgh have concluded the hearing in the House of Lords of the case, the Darlington Forge, Limited, v. the Attorney-General, on behalf of the King.

The point involved in the appeal is one of the construction of a contract in writing constituted by letters between the Ministry of Munitions and the suppliants, dated March 13 and 19, 1917, and raises the question whether the suppliants are entitled under the contract to recover from the Crown a sum of £14,570, or, in the alternative, certain larger sums. Liability to pay any sum is denied by the Crown.

The contract in question was made with reference to a proposed extension in 1917 of the whole of the company's steel furnace, gunforging, oil tempering and finishing plants at Darlington, and contained provisions for the protection and reimbursement of the company in respect of their expenditure on the extensions which might be unproductive expenditure when the output from the extensions was not required for purposes of the war.

Certain claims against the Crown were made by the company, but Mr. Justice Rowlett and the Court of Appeal decided against the suppliants. Hence the appeal to the House of Lords.

The Lord Chancellor and Lords Atkinson, Buckmaster, Carson, and Blanesburgh reserved judgment

The Attorney-General (Sir Douglas Hogg, K.C.), replying on behalf of the Crown, said the result of the abolition of the Munitions Levy was not that the Darlington Forge were unable to retain less of their profits than under the agreement, but that they had the right to retain the whole of the profits. The excess Profits Duty remained, and the sum agreed upon for writing down had been deducted in respect of that tax.

MR. W. C. GRAY AND MR. R. E. ANSELL were the authors of a joint paper on "Some Notes on the Properties of Nickel Silver," given last week before the members of the Birmingham Section of the Institute of Metals.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

Members of the Newcastle Branch spent an interesting day at South Shields on October 31.

In the afternoon the party, numbering about 100, inspected the offices of the "Shields Daily Gazette," by invitation of the directors of the Northern Press, Limited, and under the escort of Mr. M. B. Herbst, Branch-President, who is also Manager of the Northern Press engineering works.

The "Shields Gazette" was started in the year 1849, and to-day holds a prominent position among the Northern newspapers. Its offices, the main entrances to which are in Barrington Street, are well-equipped and thoroughly up-to-date.

Much of the news is now obtained by telephone and the telephone room contains an elaborate switchboard, whilst adjoining that room is the telegraph or Creed room, where the latest devices employed in the transmission of news are installed and operated.

The typographical department occupies the whole of the first floor of the east and west wings of one side of the central building. The east wing is given up entirely to the job printing business, and is fitted with the latest machinery and appliances for printing, cutting, and folding. Some of the larger types of job printing machines are also to be seen on the ground floor of the main building. The second floor in this wing forms a large paper warehouse for the jobbing department, whilst the composing room is one of the finest in the country, measuring 112 ft. x 35 ft., and is admirably heated and ventilated.

The visitors were first shown the linotype machine, of which there was a large number in operation. On visiting the foundry, much interest was shown in the making of stereotype plates and the visitors were greatly impressed by the speed of working. When completed, the plates were sent down by lift to the machine room where they were clamped to the printing cylinders of the rotary machine. This machine, which embodies the latest devices, was constructed at the works of the Northern Press Engineering Company, Limited, and occupies practically the whole of one side of a large machine room. It is capable of turning out complete newspapers, printed, folded and counted, at speeds varying from 30,000 to 60,000 per hour, according to the number of pages.

The principal rotary printing machine, linotypes and the job printing machines, are all driven electrically from the town supply.

The Members were afterwards the guests of Messrs. C. W. Taylor and Sons, Limited, North Eastern and Templetown Foundries, South Shields, at tea in the Regent Café.

The firm was warmly thanked for its kind hospitality on the motion of MR. HERBST and seconded by MR. JAMES SMITH.

MR. J. K. ARROWSMITH, replying on behalf of the Company, said it was a great pleasure to have the Members of the Institute as their guests. He thanked them for their appreciation and said that his firm had been only too pleased to do what it could to add to the enjoyment of their visit to South Shields.

The next vote of thanks was accorded to the directors of the "Shields Daily Gazette" for an interesting afternoon. This was proposed by MR. J. W. FRIER, who made a brief survey of the advance made by the "Gazette" during recent years, and of the many improvements they had seen that afternoon. The motion was supported by MR. J. PAULIN, who said that he had often been through a newspaper printing works, but had never had an opportunity of having some of the details described so vividly as he had had that day.

MR. HERBST, replying on behalf of the Northern Press, said he would convey their thanks to his directors and he hoped the visit had been successful for everyone.

Visit to Marine School.

In the evening, the Members met in the South Shields Marine School, where they listened to an interesting lecture on "The Work of an Engineering Laboratory," by the Principal of the School, Mr. H. R. Cullen, M.A.

MR. M. B. HERBST presided, and, before asking MR. CULLEN to give his lecture, mentioned some historical facts about the Marine School.

He stated that the School was founded by the late Dr. Winterbottom, who drew up the statutes for its government some years before his death in 1859. In accordance with these statutes, classes in Navigation were begun in 1861, and the present building was erected in 1868. In 1903, the Marine Engineering Department was instituted, and in 1909 the School was enlarged by the addition of seven rooms. The Marine School and its equipment in apparatus and machinery for the education of the student had developed considerably under Mr. Cullen. He (the President) knew, from the results which he had seen, that the instruction received at the South Shields Marine School was very thorough: and many of the students now held important positions in the engineering world.

The Work of an Engineering Laboratory.

MR. CULLEN thanked the President for his kind remarks and said that he was very pleased to see so large a gathering: he spoke of the foundation of the Marine School by Dr. Winterbottom and referred to the excellence of such foundations, which have been made by men who had both the power and the will to do such things; one of the most important of these was the Whitworth Scholarships. The lecturer pointed out that the Institute of British Foundrymen had itself such a foundation in the John Surtees Memorial Scheme.

The work of an engineering laboratory in a school or college may be divided into two kinds, work which was definitely instructional and educational, and work which was in the nature of investigation. An important part of the training of students in engineering was the making of experiments and the recording of results, and the interpretation of these results. If a man was once trained to do experiments properly he would be ready to tackle many kinds of investigation

In the laboratory of an engineering works also there were generally two types of things to be done, namely, the routine work of testing and gauging the quality of various things which were bought, such as coal, oil, metals, cement, etc., and the investigation of some of the things which were manufactured in the works, by examination, testing or analysis, to see why they were so good or worked so well, and also to ascertain if there was any possibility of improving them. Such work may include tests of many different kinds; in the case of coal or fuel oil, chemical analysis and measurement of calorific value; in the case of lubricating oil there were several forms of viscosity tests, whilst in the case of metals several other properties were probably needed as well as the ultimate breaking load. Where a machine or motor of any kind was manufactured it was desirable to have tests of the efficiency with which it did its work.

In the Marine School laboratory, the visitors would find, in addition to the apparatus for various experiments, two things which would probably be of particular interest to them and which would be running for their observation, namely, the quadruple expansion steam engine and the 30-tons testing machine. Before inspecting the laboratory, it seemed desirable to devote a little time to some further description of these two things. A good many special measuring arrangements were required for an experimental steam engine as compared with one which just had to do its ordinary work in the production of power for the driving of a ship or a dynamo or machinery. For an ordinary engine, the consumption of coal and the work done, may be measured for the period of a week, or of a voyage, but for experimental work it was desirable to run a trial during which the horse power and speed were kept constant, and in a trial of half an hour or so to be able to make accurate measurements, not only for the speed and I.H.P.,

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but also the B.H.P., and of the actual consumption of steam as measured from the air pump discharge. The general arrangements for the Marine School engine were described, including the water dynamometer, and the system of switch valve and two weighing tanks by which the condensed water discharged was actually weighed instead of having to be gauged.

The arrangement of straining frame and weighing beams of the 30-ton Buckton testing machine was then described, details of the method of testing being left for actual demonstration on the machine. While specimens could be tested in such a machine very rapidly for routine purposes in the works, if one were investigating or demonstrating the properties of a specimen of some metal then a long time could be spent profitably over the work. Of the data usually taken, yield point, ultimate load, extension of specimen, contraction of area, and appearance of fracture, Mr. Cullen suggested that if one had to pass or reject a specimen on one piece of information alone, probably the most important would be the fracture.

While metals were wonderful things in the service of mankind, iron and its alloys were certainly the most useful and probably the most wonderful of them. There had been a very great advance in the manufacture of both cast iron and steel during the last thirty years. Nowadays, if cast iron or steel were required for some particular purpose to have particular properties such as strength or durability of ductility, the manufacturers could give one definitely high property, so long as two outstanding features were not required from the same piece of metal: for example strength over a very great range could be obtained, but one must not demand too much elongation with a very great total strength. This has been obtained chiefly by results of tests and analysis and microscopic examination to observe the effect of small quantities of alloys in the iron or steel, and the effect of different heat treatments.

It was often said that a man should know something about everything and everything about something. In engineering a man should have a general knowledge of engineering, and then use his knowledge of engineering and science to the best advantage in the one particular thing in which he specialised. It was a mistake to specialise too soon, perhaps as bad as never specialising at all. Specialisation should consist in intimate and particular knowledge of the speciality, and not in ignorance of other things. If a man devoted his energies to the subject which turned out to be his life's work, and was ultimately able to contribute some item of advance to the knowledge of the world, then he had not lived in vain.

Discussion.

The PRESIDENT said he thought that the lecture had been most interesting and instructive, and that it gave a good illustration of the class of education received by the students who attended the day and night classes at the Marine School.

MR. C. GRESTY remarked that he had enjoyed the lecture very much, but he wished to join issue with Mr. Cullen's choice of fracture as a means of judging steel if limited to one test. In the case of mild steel he (Mr. Gresty) would choose yield point because he thought it was the most important factor for such material. The ultimate strength of two steels might be identical and yet one might have only half the yield point of the other and, therefore, he thought that if the lecturer watched the yield point he would not need to look at the fracture.

The lecturer had remarked about the inadvisability of specialising too early, with which he (Mr. Gresty) quite agreed. In this connection, however, one point in the training of an engineer was very frequently overlooked, namely, the necessity for the engineer to spend some part of his training in the foundry. As a general rule, the last place the engineering apprentice wanted to enter was the foundry, in spite of the fact that foundrywork was the real basis of an engineer's work. He thought that it should be an essential part of the training of every engineer to spend some part of his apprenticeship in the foundry.

In reply, MR. CULLEN said that when he had told them to look at the fracture he did not mean it seriously to the neglect of the other data. He would not like to pass or reject any metal, however, without having a look at the fracture. Of course, it was quite true that the reliability of the metal should be based on the yield point rather than on ultimate strength. He agreed with Mr. Gresty that an engineer ought to spend some part of his apprenticeship in the foundry.

MR. V. STOBIE said, with regard to the reliability of an engineering steel, he would join issue with both the lecturer and Mr. Gresty, because he was rather of the opinion that neither the fracture nor the yield point alone would tell the quality of the steel.

Fracture was very often a dangerous guide as regards the quality of steel because, according to the length of time taken to fracture the steel, the appearance of that fracture would change. He thought that the yield point was only a guide when other characteristics of the steel were known and, if he had to choose a single datum as a guide, then his personal preference, in the case of mild steel, would be for impact test.

In reply, MR. CULLEN said he certainly would not like to depend upon one test only. All the items mentioned were really necessary for examining the metal.

Vote of Thanks.

MR. E. WOOD (Vice-President) said it gave him great pleasure to propose a vote of thanks to Mr. Cullen for his excellent lecture. There were many engineers present, and he was sure they would all be very interested in the engine they were about to see, and those belonging to the foundry world would also be interested to see what part their castings played in the manufacture of an engine.

MR. STOBIE (Junior Vice-President) seconding the vote of thanks, said he thought they were greatly indebted to Mr. Cullen for coming to lecture to them that night.

MR. CULLEN, in reply, thanked the members for their kind appreciation, but said he thought their thanks would probably be more due to Mr. J. Forrest and Mr. H. Daish, who would give demonstrations at the engine and testing machine, than to himself.

The members then visited the laboratory, where, in addition to the 60 h.p. quadruple expansion marine steam engine, which was running at the time, and the 30-ton testing machine, there was a 6 h.p. oil engine, large sectional model of a triple expansion engine, two 6-kw. and one 3-kw. dynamos, 4 crank balancing model, and other apparatus. A demonstration was given of the breaking of test specimens in the 30-ton testing machine.

There is also a seamanship room which contains a mast 17 ft. high, with full rigging; also models of derricks, sheer legs, signalling apparatus, rocket apparatus, etc., and a number of naval architecture models.

The navigation department is well equipped with instruments, including two full size kelvin compasses, deviascopes, sextants, chronometer, globes, morse lamps, etc., while in the wireless telegraphy department there is a fully-equipped marconi ship installation of 1½ kw. At the examinations during the year 1922 for extra chief engineer, there were 12 passes from the marine school out of a total of 18 for the kingdom. Of the last 28 appointments as Engineer Surveyor to the Board of Trade, after competitive examinations during the years, 1918 to 1924, 18 were obtained by students of the Marine School.

A Waterproof Packing Paper is easily made as follows :—Completely dissolve about 2 lbs. (not more, preferably slightly less) of common white soap in about 1 quart of clean water. Dissolve 2 ozs. of gum arabic and 5 ozs. of the best commercial glue in about 1 quart of clean water. Having ascertained that both mixtures have properly dissolved, mix the two solutions together and apply heat. Soak the paper requiring waterproofing in the above solution for as long a period as is deemed necessary (the length of time, of course, depending on the class or grade and weight of paper used; heavier papers require a rather longer period in the solution than lighter papers). When thoroughly soaked, hang over an overflow or waste water tank to dry. The above method is very satisfactory and is in no way expensive.

Superheating Iron in the Cupola.*

By S. J. Felton.

Three potential thermal effects must be considered when investigating the superheating of iron in the cupola, namely:—(1) Oxidation of the metal; (2) difference between the melting and freezing-range of cast iron; and (3) heat absorption by conduction, radiation, and convection. The object of this Paper is to discuss the relative parts played by these heat sources in the cupola.

Oxidation.

Some idea of the potential superheating effect resulting from the oxidation of 0.25 per cent. silicon may be obtained from the following calculation in which the heat of slag formation is neglected. The oxidation of Si to SiO_2 gives 7,000 calories per kilogram and taking the specific heat of molten iron as 0.25 the theoretical *rise* in temperature of the iron would be:—

$$\frac{0.9975 \times 7000 \times 0.0025}{0.25} = 69.83 \text{ deg. C.}$$

Leopold Schmid,[1] by similar calculations, shows that the oxidation of 0.50 per cent. Fe, 0.20 per cent. Mn, 0.20 per cent. C., and 0.30 per cent. Si may have a superheating effect of 186 deg C. In view of the fact that some of this heat will undoubtedly be utilised to assist in melting, particularly if the oxidation is extreme, we may safely assume that the maximum amount of *superheat* to be expected from this source is limited to the above figure, 186 deg. C.

Melting Range of Cast Iron.

A large mass of information is available on the mechanism of solidification and cooling of cast iron, but there is still room for research on the heating and melting of this alloy. Under conditions of complete equilibrium a specific cast iron will melt at a certain temperature or range regardless of whether it is grey or white. There may be some difference in the manner of melting, however. A large percentage of ordinary white iron will melt as a eutectic of austenite and cementite, but as there is no free cementite in a hypo-eutectoid iron, such eutectic is not present to melt; so the equivalent melting must take place entirely as a solid solution at a constant temperature with gradual absorption of graphite, unless an austenite-graphite eutectic exists. The observations of different investigators on the plastic condition of grey iron in the melting process, should cast doubt as to the existence of an austenite-graphite eutectic, at least under the conditions of commercial heating.

It has been shown that, in practice, irons of the same ultimate composition but with different proximate or structural characteristics, may melt at different temperatures or ranges because of the unstable conditions produced by commercial melting furnaces. The experiment and calculation of Highriter and Schwartz[2] indicate that the grey iron which was heated under conditions comparable to air furnace practice, started to melt at 1,182 deg. C., and was completely fused at 1,495 deg. C. Under the higher melting speeds which may exist in the cupola, the re-absorption of graphite may be more greatly retarded, thus causing a higher melting range. There is a possibility that the large segregated graphite flakes in pig-iron, may resist re-absorption more than the finer more equally distributed graphite particles in thin castings and scrape.

Taking the mean ranges of different investigators it appears as though different cast irons may vary in melting, from 1,093 to about 1,260 deg. C. As these irons, on cooling, are not completely solidified until the eutectic point, in the neighbourhood of 1,093 deg. C. is reached; it can be seen that this difference in the melting and freezing-point may account for a superheating above freezing, of about 156 deg. C., in certain instances.

Conduction, Radiation and Convection.

The superheating effect on molten iron in the cupola, of conduction, radiation, and convection from incandescent coke, gases, and radiant lining has undoubtedly been underestimated by cupola writers in the past. Nothing could be more conducive to heat absorption than the splitting of iron up into small drops, as is done in the cupola, and then placing those drops in such close physical contact with the heating media. This is particularly true of iron which melts 46 ins. above the tuyeres, or higher, and then the drops fall intermittently from one piece of incandescent coke to another, several feet to the earth. It can be shown that if a tapping temperature of 1,465 deg. C. is obtained from an average cupola, the chilling effect of the blast and external radiation from the hearth and bottom dissipate sufficient heat so that the metal must have been heated to at least 1,537 deg. C. in the cupola. A table showing the melting and superheating of different types of irons may now be constructed, using the observations in this Paper as a guide, the oxidation losses of which, will be based on the writer's practical observations.

	A	B	C
Mean melting range of the iron, deg.C.	1,260	1,205	1,095
Temperature increase by oxidation, deg.C.	186	138	111
Temperature increase by conduction, etc., deg.C.	91	194	333

Column A represents a refractory cast iron melted in the CO_2 zone. The maximum superheat by oxidation is effected, but because of the short distance travelled by the molten metal, the absorption by conduction, etc., is small. Column B can be thought of as representing the same iron melted in the $CO + CO_2$ zone: the slower melting speed causing a lowering of the melting-range, and the higher position of melting in the stack, lessening oxidation and facilitating absorption of heat by conduction, etc. In explaining column C, the writer has melted eutectic cast iron, obtaining tapping temperatures which indicated that the metal was heated to 1,537 deg. C. in the cupola, and the oxidation losses were so small that they could only account for 111 deg. of superheat. The remaining 333 deg. must, therefore, have been obtained by conduction, radiation and convection.

In view of the predominate effect of conduction, radiation and convection, in these days of chill pig, the condition of the high temperature zones in the cupola is all important. The physical quality of the coke has an enormous effect on these zones. The writer has seen a change of 111 deg. C. in tapping temperatures result from changing to coke of different quality during a heat. This change took place long before the new coke had an opportunity to get down to the combustion zones, indicating that it was not calorific value, but physical structure which caused the change in temperature. From the description of the new Schurmann[3] cupola, it would seem as though this improvement, or modifications along this line might offer as its greatest advantage, the ability to handle varying grades of coke; because in this furnace the intermediate coke charges should have practically no effect on the blast pressure.

Cupola Theories.

The writer[4] has previously presented some theories on the cupola, the salient features of which may be summed up in four points:

(1) The use of moderate excess coke acts as a desirable safety factor, and does not lower tapping temperatures.

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* A Paper read before the Syracuse Meeting of the American Foundrymen's Association.

[1] Die Giesserei, May, 1924.

[2] H. A. Schwartz, American Malleable Cast Iron, 1922. Penton Pub. Co., Cleveland.

[3] FOUNDRY TRADE JOURNAL, April 19, 1923, pp. 322-3. The "Foundry," Dec. 15, 1923, pp. 994-6.

[4] "Foundry," May 1, 1923, pp. 351-2; "Foundry," April 1, 1924, pp. 255-7.

(2) Low melting-temperature iron must melt high in the cupola to ensure sufficient superheat.

(3) The rational method of investigating a cupola heat is to record temperature, volume, pressure, oxidation losses, etc., throughout the heat; and

(4) There is a compensating mechanism which enables satisfactory metal to be produced under a variety of cupola conditions.

Points (1) and (2) are illustrated in column C shown earlier in this discussion. This metal with a mean melting-range of 1,095 deg. C., must melt high in the stack so that the long drop of the molten metal through the hot zones will pick up the large amount of heat necessary to make up for its deficiency in melting-temperature. A moderate excess of coke is necessary to accomplish this.

Some of these points are indirectly substantiated by A. Wagner[5] in his interesting cupola investigation, in which he records pressure, tapping temperature, flue gas temperature and analysis, throughout several heats. One of his best charts, in regard to uniformity and degree of tapping temperatures, shows a high percentage of CO in the flue gases, indicating that a moderate excess of coke, or its equivalent, a moderately light blast, was being used. It is interesting to note that his tapping temperatures remained reasonably constant in most of the heats, while the pressure, flue gas temperature, and fine gas analysis varied to wide extremes. This represents additional proof, point (4).

F. Schulte and R. Spolders[6] give some interesting cupola charts showing the analysis of the metal and oxidation losses throughout the cupola heat, which is in line with point (3).

The Cupola Heat-Balance.

In most furnaces the heat-balance is of utmost importance, but this is not true in the case of the cupola. Possibly this is the reason why so few attempts have been made to strike such a balance on this furnace. Richards gave a brief, incomplete balance in his Metallurgical Calculations. Leopold Schmid give some very complete heat-balances on cupolas and reaches some interesting conclusions. In the ultimate analysis of foundry costs, however, the *thermal* efficiency of the cupola is a small item compared with its efficiency as a producer of high quality, high temperature metal. The writer contends that such results are more readily obtained with inefficient thermal operation, than when operating at the maximum thermal efficiency. The main significance of the cupola heat-balance is the determination of the amount of heat lost from the hearth and bottom, as this is at the direct expense of the temperature of the molten iron.

Methods of Increasing Superheat.

Low tuyers and continuous operation, combined with intelligent pouring methods,[6] would considerably increase pouring temperatures in many foundries.

The preheating of the blast should cause higher temperatures in the cupola, and thus result in hotter metal.

White paint, or any other means of retarding radiation from the hearth and bottom, should be beneficial, because heat lost from this area is supplied by the molten metal exclusively. Apropos of this thought, that type of wind box which allows the cold blast to circulate the hearth thus enormously increasing the rate of heat transfer from the molten metal by convection, is detrimental to high tapping temperatures, and could more profitably be replaced by some type of bustle pipe.

In the last analysis, the most positive method of increasing and ensuring superheat seems to be the duplexing, or Elliottising of cupola iron in the electric furnace.

A Reliable Caulk Joint is obtained by mixing together 1 cwt. of cast-iron borings, 17 ozs. sal ammoniac, 9 ozs. sulphur. The above mixing is highly recommended for heavy roof gutter joints.

Ammonia Iron Cement.—This cement very soon begins to rust and becomes very strong. It is both proof against steam and water. Mix together 10 parts of water, 100 parts of iron filings, and 2 parts of sal ammoniac (NH_4Cl_2).

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[5] Die Giesserei, May, 1924.
[6] S. J. Felton, The "Foundry," Feb. 15, 1923, pp. 138-140.

A Core-Making Demonstration.

Messrs. Aveling & Porter, of Rochester, recently opened their doors to a number of Kentish foundry owners for the purpose of allowing Messrs. Dixon Stacey & Company, of 34-35 Norfolk Street, Strand, W.C.2, to demonstrate a new core compound, which has recently been introduced to the trade. The procedure followed was to make cores of various sizes, large, medium and small, using new sand. They demonstrated that the use of grids and core irons could be materially reduced, and only in the larger sizes were lifting hooks necessary for handling. All the cores were black washed whilst green, and dried at a temperature of 300 deg. F. (150 deg. C.). The absence of objectional fumes and gases during drying and casting was a prominent feature. Next the ability to replace new sand by old core sands and parting sands was shown, the resultant cores being equally good, while obviously the cost was reduced. We understand arrangements are being made for other demonstrations throughout the country.

Catalogues Received.

Cast Iron Pipes.—The November stock list issued by the Staveley Coal & Iron Company, of Chesterfield, is now available.

Electrically Heated Ovens.—In connection with the forthcoming Shipping, Engineering and Machinery Exhibition, to be held at Olympia from November 23 to December 5, Messrs. Automatic & Electric Furnaces, Limited, of 173-175, Farringdon Road, London, E.C.1, have sent us an eight-page catalogue, which describes their activities in connection with electrically heated ovens. Amongst other uses, that of core drying is specified, and if the firm show an exhibit dealing with this phase we can assure them it will be of great interest to the foundry industry, as very few installations of this character exist in Europe.

Steel Sheets.—Messrs. Spear & Jackson, Limited, of Aetna Works, Sheffield, are issuing a four-page leaflet to point out the advantages they possess for the manufacture of steel sheets. We understand it is available to our readers on application.

Foundry Equipment.—The "Pneulec News" for November contains illustrated descriptions of core stoves, ladles and trolleys, cupolas and rotary sand dryers. Whilst the general style is similar to previous issues, the manner of presenting the appeal has very much improved.

Storage Bins.—In a catalogue which we have received from Messrs. Robert Jenkins & Company, Limited, of Rotherham, though it is meant as a general appeal for their cooking and heating ranges, there is described and illustrated a neat little sheet steel storage bin for anthracite, which appears to us to be very suitable for use in foundries as a container for core sand or other semi-fluid solids.

Aluminium Tubes.—Though of comparatively recent adoption by the industrial world, the amount of research data on aluminium is now probably as extensive as that on steel. To this the British Aluminium Company, Limited, of 109, Queen Victoria Street, London, E.C.4, has contributed largely. Pamphlet No. 4, issued by this company, is full of technical data and devoid of all matter which is usually designated "advertising." Except that it invites applications for other pamphlets of a similar nature.

Electric Derrick Cranes.—The Anderson Grice Company, Limited, of Carnoustie, Scotland, have sent us a 12-page art catalogue describing and illustrating their electric derrick cranes, which are made in standard sizes up to 15 tons. The exceptionally long jib makes them suitable for serving cupola slaging direct from the stockyard.

A Varnish for Workshop Blueprints.—Dissolve 1 lb. mastic and 1 lb. dammar in ½ gallon turpentine (without heat), and apply with a soft brush in a thin layer. For ordinary drawings first size them with a rather strong solution of isinglass and hot water. Allow to dry and then apply the varnish.

The Training of the Apprentice Moulder.

BY J. H. LIST.

In this article the question of obtaining apprentices for the foundry is not introduced, as a *good* foundry manager can always get sufficient apprentices. A suitable course for the training of the apprentice moulder should last five years. The boys should be admitted into the foundry on leaving school at the age of between 14 and 15.

The foundry manager should personally give the apprentices at least half an hour of his time daily, for it will be the best spent time of his day. For the first year, that is, until he reaches the age of 16, the boy should always be working with a skilled moulder. If the boy is put on small work by himself too early he will seldom get the chance of drawing upon the experience of the skilled moulder.

For the second year he should be put in a specially laid-off bay. The class of work he will get naturally varies with the shop he is in, but on no account should he be put on long periods of repetition work, as it makes a machine of him and destroys initiative. Some machine moulding, however, is necessary, but not for too long a period on the same job. The next two years—that is, 17 to 19—the apprentice should be given more difficult jobs, including cored work, and should be afforded an opportunity of working in the core shop. The next year (19 to 20) the apprentice should be taken from the special bay and put to work with one of the leading moulders, and, preferably, be moved from one leading moulder to another, spending about two months with each. This year is the one where a good apprentice learns more than in all the rest of his time. He is old enough to grasp ideas and make allowances in his own mind for changing, if necessary, ideas he gained whilst working in the special bay.

In the last year of the apprenticeship he should be given first-class jobs, and be personally assisted by the foreman or his assistant.

The foregoing would be a good grounding so far as shop work was concerned, but in a busy foundry the managers or foremen have no time to enter into the principles of the art, or to give any instruction on the cupolas or lifting plant, etc. Thus it is essential that when the boy reaches 16 he must attend evening classes. Up to this age the boy must necessarily get familiar with the terms and ways of the foundry.

In some of the largest British shops all the apprentice moulders are in one section under the direct control of a special foreman. This system is good, but none will be better moulders than their instructor, or at least their ideas will be narrowed down somewhat.

The initial difficulty in conducting evening classes is to get the boys to attend. There should be an examination carrying a national certificate: this should preferably be annual, and in the fourth year carry with it an associateship of the examining body for the successful student. The absence of such conditions is the sole cause of non-attendance. Some correspondence has appeared in THE FOUNDRY TRADE JOURNAL on this subject, but so far nothing has matured.

It is suggested that the first and second year of these classes should take the form of a series of lectures with blackboard sketches, and cover the following:—Sands, scabs, venting, how the gases escape from the moulds, the use of coal dust, the use of blackings, and kindred subjects. The third and fourth years could profitably be spent by taking examples of moulds, and explain how the job should be done, with the help of blackboard sketches. These lectures should include green sand, dry sand, loam work, strickle work, and cupola practice. A certain portion of the last year should also be spent in actual practical work, moulding small difficult jobs, more particularly to show how patterns are taken out of the sand, including in this double turnover work, green sand core work, draw back jobs. In every case it should be shown where the venting is necessary, and where the runners and risers should be, with explanatory notes. In one small moulding shop attached to the school where the author teaches the moulds wherever possible are cast in lead. This makes the work much more interesting to the boys. The work must be made interesting, or it will be difficult to retain the boys. Questions and conversations should be encouraged within limits.

Typical questions for third-year students set by the author in the annual examination are appended:—

(1) The use of cores may be said to come under two headings, viz.:—(*a*) A necessity; (*b*) an expedient. Give short examples of each. (10.)

(2) Explain the difference between a chill and a densener. (10.)

(3) Calculate the weights of the castings made from the following patterns:—(*a*) When the weight of a pattern, having no cores at all, is 33¼ lbs.; (*b*) of a bend pattern, both ends spigot, 12 in. bore, 1 in. thick, and measures 3 ft. from centre to end of spigot each way. (12.)

(4) State fully the use of coal dust. (12.)

(5) Explain briefly the difference between a sound casting, and a casting having a good surface, and give an explanation of each. (12.)

(6) Is it possible to cast a mould too hot, as well as too cold? (14.)

(7) Give three chief factors governing the design of a cupola. (15.)

(8) Give a short account of how you would make a mould from a pattern of a gear wheel, 3 ft. 6 in. dia., having 40 teeth. The pattern only provides six teeth on a segment, otherwise it is a complete pattern. The weight of the casting is 15 cwt. (15.)

The number of marks awarded are given in parentheses.

X-Rays in Aluminium Foundry Practice.

Dr. R. J. Anderson, in an interesting Paper read before the Syracuse meeting of the American Foundrymen's Association, entitled "X-Ray Examination of Aluminium-Alloy Castings for Internal Defects," pointed out that X-Ray examination promises to be one of the most important testing methods in foundry practice, and it is particularly well adapted to aluminium-alloy castings because of the relatively high transparency of aluminium. The advantages of the X-Ray examination method are stated to be:—(1) Inspection may be made without cutting or otherwise damaging parts. (2) Dangerous flaws which might cause failures can be detected before the parts are put in service. (3) Flaws which might be uncovered in machining can be located before expensive machine work is done. (4) Correlation of the nature, amount, and distribution of internal defects in castings may be made with the method of gating or some other important factor, thus permitting the use of smaller sections and a lower factor of safety with simultaneous decrease in cost. The cost for aluminium-alloy examinations is stated to be relatively low when using radiator type tubes. He described the apparatus and equipment for radiography, together with the method of making exposures for examination of aluminium-alloys. In the experiments detailed, two types of equipment were used: a Victor-type deep therapy machine with high voltage Coolidge tube capable of operation up to about 260 kv., and a self-rectifying unit, with a radiator-type Coolidge tube, capable of operation in the range 55-90 kv. Typical radiographs made on some aluminium-alloy castings were illustrated and explained.

A Good Rust Cement for Iron.—Mix together 66 parts of wrought-iron filings, 2½ parts of sal ammoniac (NH_4Cl_2), 1¼ parts of flour sulphur, and 1 part of diluted sulphuric acid (H_2SO_4). The acid is added after solid ingredients are mixed together. This cement dries in the course of a few days and unites with the iron, making a hard, resisting, weatherproof mass.

Trade Talk.

E. S. JOHNSON & COMPANY, LIMITED, have removed to 57, Heath's Court, Manor Chare, Newcastle-on-Tyne.

CRANKLESS ENGINES, LIMITED, have removed their London office from Aldwych House, Aldwych, W.C.2, to 20, Grosvenor Gardens, S.W.1.

A SERIOUS FIRE occurred recently at the works of Moss & Gamble Brothers, Limited, steel manufacturers, of Russell Street, Sheffield. The file-cutting shop was gutted.

GEORGE SLATER, LIMITED, Attercliffe Road, Sheffield, have recently purchased the Bagnall Forge and Engineering Works at South Hylton, near Sunderland, and dismantling has already begun.

W. T. CLARK & COMPANY (METAL SPINNERS), LIMITED, Reading Lane, Hackney, E.8, have appointed Mr. S. A. Wilkins, 34, Hamilton Crescent, Palmers Green, as their agent for London north of the Thames.

THE FOSTER ENGINEERING COMPANY, LIMITED, Morden Works, Wimbledon, S.W.19, have established branches at 140B, Victoria Street, Bristol, and 37, South Castle Street, Liverpool. Mr. G. S. Williams is in charge of the latter and Mr. W. J. Murphy the former.

MR. W. HOLLAND, 14, Highfield Road, Stretford, Manchester, has been appointed representative for Birmingham and the Black Country for Thos. E. Gray & Company, Limited, manufacturers of Silacene, 119, High Holborn, London, W.C.1.

THE ASCERTAINED PRICE of West Coast hematite mixed numbers for September and October, is £3 17s. 6.71d., a reduction of 3s. 0.43d. According to the new agreement, the sliding scale percentage on base rates remains 16 per cent. The percentage on bonus earnings for the Workington area is 46¾ and for the Furness area 41¾.

THE LILLESHALL COMPANY, LIMITED, of Shifnal, Salop; the New South Wales Railways and Tramways, Sydney, N.S.W.; and the Titan Foundry and Engineering Company, Limited, Cardiff, have joined the British Cast-Iron Research Association. The British Drying and Heating Company have also joined as trade members.

WE UNDERSTAND that the 10,000-h.p. Cockerill gas engine recently installed at the Devonshire Works of the Staveley Coal & Iron Company, Limited, has given such satisfaction that an order has been placed for two similar engines, which will, when finished, increase the output of the generating station from 15,000-k.w. to 25,000-k.w.

THE L.N.E.R. COMPANY have now completed their locomotive and wagon constructional programme for 1926. Most of the work to be undertaken will be completed in the company's own workshops. The programme includes the construction of 148 new locomotives for both passenger and goods work. Forty suburban-type locomotives now operating on the London suburban services will be replaced by 63 new suburban locomotives of an improved design, the locomotives thus withdrawn being used mainly for goods shunting work in other parts of the company's system. Twenty-eight new locomotives of a 4-4-0 improved "Director" type are also to be constructed in order to supplement the working of the Pacific locomotives which are operating to advantage on the main-line services of the company. Altogether £630,000 is to be spent on new locomotives during 1926. The programme also includes the construction of 7,400 new wagons of varying types. Altogether over £1,250,000 will be spent by the L.N.E.R. in 1926 on the construction of new wagons.

THE MEMBERS of the Women's Engineering Society have received an invitation from the president and officers of the Shipping, Engineering and Machinery Exhibition to visit Olympia on November 24. Visits of other societies have been fixed on the following dates:—Wednesday, November 25: Institution of Structural Engineers; Society of Engineers; Institution of Welding Engineers. Thursday, November 26: Institution of Naval Architects. Friday, November 27: Institute of Marine Engineers; Institution of Locomotive Engineers. Saturday, November 28: Junior Institute of Engineers; Institute of British Foundrymen. Monday, November 30: Institution of Chemical Engineers. Wednesday, December 2: British Acetylene and Welding Association; Institution of Gas Engineers; Institution of Heating and Ventilating Engineers. Thursday, December 3: Cable Makers' Association; Ship and Boat Builders' Association. Friday, December 4: British Cast Iron Research Association; Institute of Metals; Institution of Mechanical Engineers; Whitworth Society. Saturday, December 5: Institution of Production Engineers. In regard to the following societies the actual date has not been fixed:—Institution of Electrical Engineers; Institution of Engineers-in-Charge; Institution of Mining and Metallurgy; North-East Coast Institution of Engineers and Shipbuilders; and Society of Technical Engineers.

Personal.

MR. H. L. CRITCHLEY, works manager to Beyer, Peacock & Company, Limited, Manchester, has resigned, to become general manager to Babcock & Wilcox, Limited, Renfrew.

MR. L. T. SWIFT, who has long been engaged in the metallurgical research department of Hadfields, Limited, of Hecla Works, Sheffield, is shortly leaving this country to take up an appointment with the concerns of Terni & Magona, in Italy.

MR. R. ARRAND, for some time in the accountants' department at the Millom Iron Works, has been appointed secretary to the Millom and Askam Hematite Iron Company, Limited, in place of Mr. H. J. Kirby, whose resignation we announced last week.

MR. AMBROSE FIRTH has been the recipient of a presentation from the officials and men at the Ecclesfield Works of the Brightside Foundry and Engineering Company, Limited, and its subsidiary company, John Robinson (Royds' Foundry), Limited, on the occasion of his marriage. Mr. Firth is a director of both companies. Mr. J. A. Ayres, general manager of the Ecclesfield Works, made the presentation, and commented on the good feeling that had always existed between the directors and the staff.

Wills.

WARDLE, W., of Olive Lane, Wavertree, Liverpool, tinplate and metal merchant	£3,580
GRANT, R., of Guest Road, Prestwich, Lancs., branch manager of Stewarts & Lloyds, Limited	£17,784
COOKE, T. J., of Clarendon Road, Edgbaston, Birmingham, and of Wolverhampton, brassfounder	£5,424
BARTRAM, SIR ROBERT APPLEBY, of Bartram & Sons, Limited, shipbuilders, Sunderland	£217,813
DENISON, S., of West Park, Leeds, head of Samuel Denison & Sons, Limited, Hunslet Foundry	£14,310
WILD, A. G., founder and managing director of A. G. Wild & Company, Limited, railway supply works, Darnall	£7,690
BLAYLOCK, R., of West Lea, Woodlands Road, Darlington, a director of the Darlington Forge & Engineering Company, Limited	£14,280

Company Reports.

Siemens Brothers, Limited.—Interim dividend, 5 per cent. per annum for half year.

W. T. Henley's Telegraph Works Company, Limited.—Interim dividend, 1s. per share, less tax.

Brunner, Mond & Company, Limited.—Interim dividend on ordinary shares, 7 per cent. per annum.

Dennis Brothers, Limited.—Final inclusive dividend, 20 per cent., making 25 per cent. for year, less tax.

Pettigrew and Merriman (1925), Limited.—Dividend on 7½ per cent. preference shares will be paid in two equal instalments in second week of January and June, 1926.

Zinc Corporation, Limited.—Dividend, 2s. on preference shares, making 20 per cent. for 1925; interim participating dividend, 3s. on both preference and ordinary shares, less tax.

Venesta, Limited.—Net profit, £58,284; brought forward, £56,558; total, £114,842; preference dividend, £21,000; dividend on ordinary shares, 8 per cent; carried forward, £69,116.

Weardale Lead Company, Limited.—Profit, £23,687; writing down plant, etc., £3,724; reserve, £4,500; final dividend, 2s. 6d. per share, making 17½ per cent. for year; carry forward, £5,478.

United Engineers, Limited.—Profit, £92,177; reserve, £18,173; writing down of stocks, £15,104; brought forward, £14,848; dividend, 7 per cent. on preference shares, £12,250; dividend, 6 per cent. on ordinary shares, £55,723; carry forward, £5,774.

MR. C. H. SITCH, M.P., general secretary of Chainmakers' Operatives, in an address to the members last week, said the export trade was hardly as good this year as last. Exports of chains and anchors to all countries for the first nine months of 1923 totalled 10,728 tons; for the first nine months of 1924, 12,275 tons; and for the first nine months of 1925, 11,478 tons, or 797 tons down. The executive council had in hand the question of foreign iron (which was more difficult to weld than average English iron). It was now only a question of mutual agreement as to the kind of action to be taken so far as wages were concerned.

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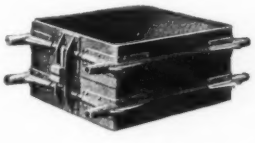

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BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

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The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The improvement in the Cleveland trade previously reported has been steadily maintained, and the tone of markets already indicates a distinctly firmer tendency. It is, however, unusual for home consumers at this period of the year to extend purchases to any great extent, and, as a rule, buyers are now satisfied with covering requirements of more immediate urgency. It is also satisfactory to note that Scotland has resumed buying on a freer scale, while a substantial export trade is developing with America. Not only are special foundry qualities going to the U.S.A., but several substantial cargoes of ordinary No. 3 have just been sold for the same destination. At this week's market quotations were firmly held as follow:—No. 1, 69s.; No. 3 G.M.B., 66s.; No. 4 foundry, 65s.; and No. 4 forge, 64s. per ton.

In the Tees-side hematite market a stronger all-round demand has also developed, and although the output is being increased, the total production is still barely equal to the increasing demand. The home trade is much healthier, and, although on the Continent there is the competition of cheap French material to face, it is gratifying to note that sales to Europe are showing further improvement. Whilst in some cases mixed numbers can still be done at 74s. 6d. per ton, this figure is very firmly held, and in other instances sellers are holding out for 75s. per ton, with No. 1 quality quoted at the usual premium of 6d. per ton. On the North-West Coast prices are a little firmer, with Bessemer mixed numbers quoted £4 1s. 6d. c.i.f. Welsh ports, £4 4s. per ton delivered at Glasgow, £4 8s. 6d. per ton delivered at Sheffield, and £4 12s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Quotations in the Manchester market for foundry pig again show a decidedly firmer tendency, No. 3 Derbyshire iron now ruling at 73s. 6d., and it is doubtful whether any offer at less than this figure would be accepted. Some sellers ask 74s. per ton delivered, and for Lincolnshire iron the price ranges from 72s. 6d. to 73s. There is now no Northamptonshire iron offering, as the price would be higher than that from Derbyshire. Forward business has been done up to March, but apparently the greater part of it was up to the end of the year only. Hence if business in the foundry trade revives, there might be some sharp buying early in January.

THE MIDLANDS.—The improved local demand for foundry pig-irons which has been noticeable recently is well maintained, and a fair number of consumers in the Black Country has covered requirements up to Christmas, having come to the conclusion that buyers do not stand to lose much, even if they are not open to gain. Current quotations now rule as follow:—Derbyshire No. 3 foundry, 65s.; Staffordshire No. 3 foundry, 65s.; Northants. No. 3 foundry, 62s. 6d.

SCOTLAND.—Conditions in this area, though slower of recovery than in the southern centres, also give an impression of increasing activity, but so far this has not materialised into an expansion in the volume of business passing, and, in fact, the price of Scotch No. 3 foundry is easier to-day at 78s. per ton f.o.t. furnaces. There has been very little demand of late for Cleveland iron, and, whilst the makers are firm in their ideas at 70s. for No. 3 f.o.t. Grangemouth, a little business has been done here at well under this figure.

Finished Iron.

Throughout the South Staffordshire and other districts the ironworks are anything but busy, and it is only with great difficulty that they can keep up part-time operations. They are all eager for specifications, and this state of affairs only tends to further price-cutting. It is now possible to obtain crown iron from various sources at £11 10s. delivered and nut and bolt iron round about £10 7s. 6d. to £10 10s. There is even less business for the latter iron than there is for crown, as the bulk of the nut and bolt makers' orders are going abroad, as the difference in price is so very considerable. There are many offers from the French and Belgian works at £6 12s. 6d. to £6 15s. delivered works in this district, and whilst the disparity between the English and foreign price is so great, supplies for the local works would be very spasmodic, and bulk tonnage will be quite out of the question. There is no alteration in the price of Staffordshire marked bars, the figure remaining at £14 10s. at works. The mills are moderately busy on this class of iron, and it is reported that inquiry is somewhat better.

Steel.

In the Sheffield steel market there is a fair amount of buying of acid billets, and the demand for basic material is also slightly better. The production of crucible steel is beginning to expand, and a few more Siemens steel furnaces are being put into operation. In the special steel section things are looking up, but in ordinary steels there is a less noticeable improvement. South America and South Africa are two valuable customers at present. Railway work is better again, and some fairly substantial contracts are being placed. All round, the trade outlook is becoming more encouraging. The tinplate market of late has developed a slightly stronger tone, most makers being fairly well booked up over the remainder of the year.

Scrap.

So far, the increased demand for pig-iron, as outlined above, has had little effect upon markets for scrap metals, business remaining generally quiet and disappointing. In the Lancashire foundry scrap market consumers are still expecting to obtain supplies of broken machinery metal at 70s. per ton and are disinclined to pay more except for "textile" quality. Dealers, on the other hand, try to keep the price at 72s. 6d., and some few sales have been made at that figure, although not to any extent. Of course, a revival in the demand for castings would soon lead to a much better market for cast scrap, but even if such a revival has begun, it moves very slowly at present. In Scotland machinery cast-iron scrap still shows practically no change at 70s. to 71s. 3d. per ton. Ordinary cast-iron scrap is still 65s. per ton. The position of old cast-iron railway chairs is rather abnormal, as these are at prices equal to machinery cast-iron scrap on account of the supply and demand. Light cast-iron scrap and firebars are still around 55s. to 56s. per ton.

Metals.

Copper.—A somewhat weaker tendency in the values of standard copper has developed during the past week, but, so far, the market continues steady, with fluctuations in quotations mostly confined within narrow compass. At the moment the metal is devoid of any special interest, the market evidently being a waiting one. There is by no means a pessimistic feeling, fluctuations in warrant metal having been narrow in spite of the spasmodic character of dealings. Current quotations:—*Cash*: Thursday, £61 15s.; Friday, £61 15s.; Monday, £61 2s. 6d.; Tuesday, £61; Wednesday, £61.

Three Months: Thursday, £62 12s. 6d.; Friday, £62 12s. 6d.; Monday, £62 2s. 6d.; Tuesday, £62; Wednesday, £62.

Tin.—Notwithstanding that the statistical position remains inherently sound, tin values continue for the time being to fluctuate in a surprising manner, although the close of the markets last week indicated a further upward movement. The outlook continues to be regarded with confidence, as it is anticipated that the lull in the American demand will not be of long duration. Stocks have fallen during the last two months by 4,200 tons, and now stand at 15,200 tons, in spite of a considerable increase in the Straits output. There was a slight set-back in the October deliveries in America compared with September, but their absorption this year has been at the rate of 78,000 tons per annum, as against 64,200 tons in the previous year. Current quotations:—*Cash*: Thursday, £286; Friday, £287 15s.; Monday, £287; Tuesday, £284 17s. 6d.; Wednesday, £287.

Three Months: Thursday, £283; Friday, £284 15s.; Monday, £284 5s.; Tuesday, £282 5s.; Wednesday, £283 10s.

Spelter.—Movements in this section of the market of late have disclosed few features of interest, and though home values are a shade weaker on the whole, American advices are favourable to a more active demand for the metal in the near future. Current quotations:—*Ordinary*: Thursday, £38 17s. 6d.; Friday, £38 12s. 6d.; Monday, £38 6s. 3d.; Tuesday, £38; Wednesday, £38.

Lead.—The market for soft foreign pig is less satisfactory than could have been expected after the recent strong demand, this being due to renewed liquidation by dealers in view of the fact that trade needs have been slowing down, as usually happens towards the end of the year, and also on account of indications of better supplies from Australia. The forthcoming arrivals, which will partly represent old accumulations that were held up by the strike, will be quite substantial, as over 10,000 tons were shipped from Australia during September. Current quotations:—*Soft foreign (prompt)*: Thursday, £37 11s. 3d.; Friday, £37 5s.; Monday, £36 12s. 6d.; Tuesday, £36 11s. 3d.; Wednesday, £36 12s. 6d.

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863

JAS. DURRANS & SONS, LTD.

PHOENIX WORKS, PENISTONE, near SHEFFIELD.

Telephone:
21 PENISTONE.

Telegrams:
"DURRANS, PENISTONE."

Manufacturers of

FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
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CORE ROPES.
BUCKETS,
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Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

NOTICE

NEW ALLDAYS & ONIONS, LTD.,

HAVING PURCHASED THE GOODWILL OF

THWAITES BROS.,

OF BRADFORD,

ARE NOW CONTINUING THE MANUFACTURE OF THE **THWAITES** PRODUCTIONS AT THEIR BIRMINGHAM WORKS.

CUPOLAS, BLOWERS, FANS, STEAM & PNEUMATIC HAMMERS, FURNACES, FOUNDRY & SMITHY PLANTS, ETC.

ADDRESS ALL ENQUIRIES TO—

NEW ALLDAYS & ONIONS, LTD.,
GREAT WESTERN WORKS,
BIRMINGHAM.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	61	0	0
Three months	62	0	0
Electrolytic	67	10	0
Tough	63	10	0
Best selected	64	0	0
Sheets	92	0	0
India	79	0	0
Wire bars	68	5	0
Do. Dec.–Jan.	67	15	0
Do. Jan.	68	0	0
Ingot bars	67	15	0
H.C. wire rods	72	5	0
Off. av. cash, Oct. 62	0	9	6/11
Do., 3 mths. Oct. 62	18	9	
Do., Sttlmnt, Oct. 62	0	6	9/11
Do., Electro, Oct. 67	14	3	9/11
Do., B.S., Oct.	65	1	11½
Aver. spot price copper, Oct.	62	0	6¾
Do., wire bars, Oct.	67	18	2½

Solid drawn tubes 13¼d.
Brazed tubes 13¼d.
Wire 10d.

BRASS.

Solid drawn tubes 12d.
Brazed tubes 13½d.
Rods, drawn 11½d.
Rods, extd. or rlkd. 7½d.
Sheets to 10 w.g 10¾d.
Wire 10¾d.
Rolled metal 10½d.
Yellow metal rods 7½d.
Do. 4 × 4 Squares 8d.
Do. 4 × 3 Sheets 8½d.

TIN.

	£	s.	d.
Standard cash	287	0	0
Three months	283	10	0
English	287	0	0
Bars	287	0	0
Straits	293	0	0
Australian	290	0	0
Eastern	292	0	0
Banca	294	0	0
Off.aver. cash, Oct.	277	17	3 3/11
Do., 3 mths., Oct.	278	0	11 12/22
Do., Sttlmt. Oct.	277	16	9 9/11
Aver. spot., Oct.	277	16	9¾

SPELTER.

	£	s.	d.
Ordinary	38	0	0
Remelted	36	10	0
Hard	31	5	0
Electro 99.9	42	5	0
English	38	12	6
India	32	10	0
Zinc dust	45	0	0
Zinc ashes	15	0	0
Off. aver., Oct.	39	5	4 17/22
Aver., spot, Oct.	39	17	8

LEAD.

	£	s.	d.
Soft foreign ppt.	36	12	6
English	38	0	0
Off. average, Oct.	37	19	0¾
Average spot, Oct.	39	0	4

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	46	10	0
Do. V.M. (x whf.	45	10	0
Rods	53	0	0
Boiler plates	44	10	0
Battery plates	45	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	90	0	0
Chinese	80	0	0
Crude	63	0	0

QUICKSILVER.

Quicksilver £14 7 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon
45/50% £11 17 6
75% £21 0 0
Ferro-vanadium—
35/40% 15/9 to 16/– lb. va.
Ferro-molybdenum—
70/75% c. free 6/3 lb.
Ferro-titanium—
23/25% carbonless 1/– lb.
Ferro-phosphorus, 20/25%, £22 0 0
Ferro-tungsten—
80/85%,c.fr. 1/8 lb.
Tungsten metal powder—
98/99% 1/10½ to 1/11lb.
Ferro-chrome—
4/6% car. £24 5 0
6/8% car. £22 18 6
8/10% car. £22 12 6
Ferro-chrome—
Max. 2% car. £40 10 0
Max. 1% car. £51 0 0
Max.0.70%car. £56 10 0
70%, carbonless 1/5 lb.
Nickel—99%,
cubes or pellets £170 to £177
Cobalt metal—98/99%
10/3 lb.
Aluminium 98/99% £120
Metallic Chromium—
96/98% 3/6 lb.
Ferro-manganese (net)—
76/80%, loose £15 7 6
76/80%, packed £16 7 6
76/80%, export £15 5 0
Metallic manganese—
94/96%, carbonless 2/1 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over 4d.lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼in. to ⅛ in. 1/– lb.
Flats, ½in.×¼in. to under 1 in.×⅛ in. 3d. lb.
Do. under ½in.×¼in. 1/–lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10%extra
Scrap from high-speed tool steel—
Scrap pieces 3d.
Turningds andwarf 1d.
Per lb. net, d/s steel makers' work

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Hvy. steel	3	8	6 to	3	12	6
Bundled steel & shrngs.	3	2	6 to	3	6	6
Mixed iron & steel	3	2	6 to	3	5	0
Heavy cast iron	3	5	0 to	3	8	6
Good machinery for foundries	3	10	0 to	3	12	6

Cleveland—	£	s.	d.
Heavy steel	3	0	0
Steel turnings	1	17	6
Cast iron borings	1	15	0
Heavy forge	4	5	0
Bushelled scrap	3	0	0
Cast-iron scrap	3	0	0 to 3 1 0

Lancashire—	£	s.	d.	£	s.	d.
Cast-iron scrap	3	10	0 to	3	12	6
Heavy wrought	3	5	0 to	3	7	6
Steel turnings	2	0	0			

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	53	0	0
Brass (clean)	41	0	0
Lead (less usual draft)	33	10	0
Tea lead	29	10	0
Zinc	27	0	0
New aluminium cuttings	92	0	0
Braziery copper	48	0	0
Gunmetal	47	0	0
Hollow pewter	195	0	0
Shaped black pewter	142	0	0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1	69/–
Foundry No. 3	66/–
Foundry No. 4	65/–
Forge No. 4	64/–
Hematite No. 1	75/–
Hematite M/Nos.	74/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	84/–
„ d/d Birm.	92/6
Midlands—	
Staffs common*	—
„ No. 4 forge	62/6
„ No. 3 foundry	65/–
Shrops. basic	70/–
„ Cold blast, ord.*	185/–
„ „ roll iron*	190/–
* d/d Birmingham.	
Northants forge	57/6
„ fdry No. 3	62/6
Derbyshire forge	60/–
„ fdry. No. 3	65/–
„ basic	65/–
Scotland—	
Foundry No. 1	83/6
„ No. 3	78/–
Hem. M/Nos.	78/6
Sheffield (d/d district)—	
Derby forge	64/–
„ fdry. No. 3	68/–
Lincs. forge	67/–
„ fdry. No. 3	69/6
E.C. hematite	85/–
W.C. hematite	88/6
Lincs. (at furnaces)—	
Forge No. 4	61/–
Foundry No. 3	63/6
Basic	65/6
Lancashire (d/d eq. Man.)—	
Derby forge	67/6
„ fdry. No. 3	73/6
Northants foundry No. 3	75/3
Dalzell, No. 3	110/–
Summerlee, No. 3	95/6
Glengarnock, No. 3	95/6
Gartsherrie, No. 3	95/6
Monkland No. 3	95/6
Coltness, No. 3	95/6
Shotts, No. 3	95/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	5	0 to	12	10	0
Angles	11	10	0			
Tees to 3 united ins.	12	0	0			
Nut and bolt	11	0	0			
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t.	14	10	0			
Gas strip	12	10	0 to	12	15	0
Bolts and nuts ¾ in. × 4 in.	16	15	0			

Steel—	£	s.	d.	£	s.	d.
Ship plates	7	5	0 to	8	7	6
Boiler plts.	11	10	0			
Chequer plts.	£9	15	0 to	10	5	0
Angles	£7	0	0 to	7	10	0
Tees	£8	5	0 to	8	10	0
Channels	£6	17	6 to	7	7	6
Joists	£7	0	0 to	7	10	0
Rounds and Squares 3 in. to 5¼ ins.	8	10	0			
Rounds under 3 in. to ⅜ in.	8	5	0			
Flats, over 5 in. wide and up	9	0	0			
Flats, 5in. to 1¼in.	8	0	0			
Rails, heavy	8	0	0			
Fishplates	12	10	0			
Hoops (Staffs.)	10	10	0			
Black sheets, 24g.	11	5	0			
Galv. cor. sheets, 24g.	16	12	6			
Galv. fencing wire 8g. plain	14	0	0			
Billets,soft £6	0	0	to 7	10	0	
Billets, hard	8	12	6			
Sheet bars	6	5	0			
Tin bars d/d	6	5	0			

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	4
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½

Wire round—
3/0 to 10 G. 1/6½ to 2/1½
with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.26
No. 2 foundry, Valley	21.76
No. 2 foundry, Birm.	21.00
Basic	21.26
Bessemer	22.26
Malleable	21.76
Grey forge	21.26
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	2.00
Tank plates	1.80
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.25
Sheets, galv., No. 28	4.50
Sheets, blue an'l'd, 9 & 10	2.40
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	£5.50

COKE (at ovens).

Welsh foundry 32/6 to 37/6
„ furnace 20/– to 25/–
Durham & North.
„ foundry 30/– to 33/–
„ furnace 15/– to 15/6
Other Districts, foundry 30/– to 33/–
„ „ furnace (basis) 11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20×14, box		20/–
„	28×20, „	40/–
„	20×10, „	29/4½
„	18¾×14, „	20/10½
C.W.	20×14, „	18/1½
„	28×20, „	36/3
„	20×10,	25/1½
„	18¾×14, „	18/7½

Terneplates 28 × 20, 36/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered £19/0 to £20/0
Rolled Ord. £16/0/0 to£16/10/0
Nail rods £16 5 0 to £16 15 0
Keg. steel nom. £33 to £35
Faggot steel nom. £22 to £25
Blooms, according to quality £10 to £14
Pig-iron £6 15 0 to £7 0 0 all f.o.b. Gothenburg.

TUBES.

	Up to and incl. 6 in.
Gas .. 55%	Tube prices are now free.
Water .. 50%	
Steam .. 45%	

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Nov. 12	61	15	0	inc. 5/-
,, 13	61	15	0	No change
,, 16	61	2	6	dec. 12/6
,, 17	61	0	0	,, 2/6
,, 18	61	0	0	No change

Electrolytic Copper.

	£	s.	d.	
Nov. 12	68	5	0	inc. 5/-
,, 13	68	5	0	No change
,, 16	67	15	0	dec. 10/-
,, 17	67	15	0	No change
,, 18	67	10	0	dec. 5/-

Standard Tin (Cash).

	£	s.	d.	
Nov. 12	286	0	0	inc. 107/6
,, 13	287	15	0	,, 35/-
,, 16	287	0	0	dec. 15/-
,, 17	284	17	6	,, 42/6
,, 18	287	0	0	inc. 42/6

Tin (English ingots).

	£	s.	d.	
Nov. 12	286	0	0	inc. 105/-
,, 13	287	15	0	,, 35/-
,, 16	287	0	0	dec. 15/-
,, 17	285	0	0	,, 40/-
,, 18	287	0	0	inc. 40/-

Zinc Sheets (English).

	£	s.	d.	
Nov. 12	46	0	0	No change
,, 13	46	0	0	,, ,,
,, 16	46	0	0	,, ,,
,, 17	46	10	0	inc. 10/-
,, 18	46	10	0	No change

Spelter (ordinary).

	£	s.	d.	
Nov. 12	38	17	6	No change
,, 13	38	12	6	dec. 5/-
,, 16	38	6	3	,, 6/3
,, 17	38	0	0	,, 6/3
,, 18	38	0	0	No change

Lead (English).

	£	s.	d.	
Nov. 12	38	15	0	No change
,, 13	38	15	0	,, ,,
,, 16	38	5	0	dec. 10/-
,, 17	38	0	0	,, 5/-
,, 18	38	0	0	No change

Exports of Iron Castings in October and the ten months, 1925, compared with October and the ten months, 1924.

	Oct., 1924.	Oct., 1925.	Ten months, 1924.	Ten months, 1925.	Oct., 1924.	Oct., 1925.	Ten months, 1924.	Ten months, 1925.
BUILDERS' CASTINGS:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—								
To Argentine Republic	116	129	1,141	1,311	3,752	4,734	40,117	47,602
,, British South Africa	238	402	2,662	3,165	8,306	13,403	92,111	110,768
,, ,, East Indies	105	149	1,086	1,448	4,255	6,910	46,019	66,409
,, Australia	86	79	677	604	4,804	4,421	37,828	33,951
,, New Zealand	201	283	1,691	2,310	10,736	13,147	83,337	107,761
,, Other countries	558	808	5,371	6,636	30,091	43,050	272,887	337,833
Total	1,304	1,850	12,628	15,474	61,944	85,665	572,299	704,324
PIPES AND FITTINGS:—								
Cast—								
To Argentine Republic	1,210	742	7,189	9,870	18,506	9,522	100,815	126,967
,, British South Africa	286	238	6,070	5,435	4,217	4,454	79,119	78,759
,, ,, India	607	808	9,467	8,199	8,837	12,640	140,118	118,144
,, Straits Sttlmts. & Malay States	112	613	7,811	5,068	1,698	6,134	97,933	59,220
,, Ceylon	138	96	882	1,093	2,069	1,332	12,408	13,754
,, Australia	417	220	3,795	2,635	5,774	3,584	58,825	42,602
,, Other countries	3,909	4,796	35,973	46,976	61,389	71,462	606,394	691,753
Total	6,679	7,513	71,187	79,276	102,490	109,128	1,095,612	1,131,139
HOLLOW-WARE:—								
Cast, not Enamelled, & Cast, Tinned	597	734	5,468	6,896	22,453	24,812	218,150	232,277
,, Enamelled	74	89	893	838	7,974	8,980	92,018	86,280
CASTINGS in the rough:—								
Iron	153	311	1,285	1,431	5,529	11,365	52,260	50,714
Steel	54	132	2,048	689	2,032	6,677	39,985	29,399

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7.—Steel Bars and Blooms.
8.—Steel Castings (Wheel Centres).
9.— do. (Miscellaneous).
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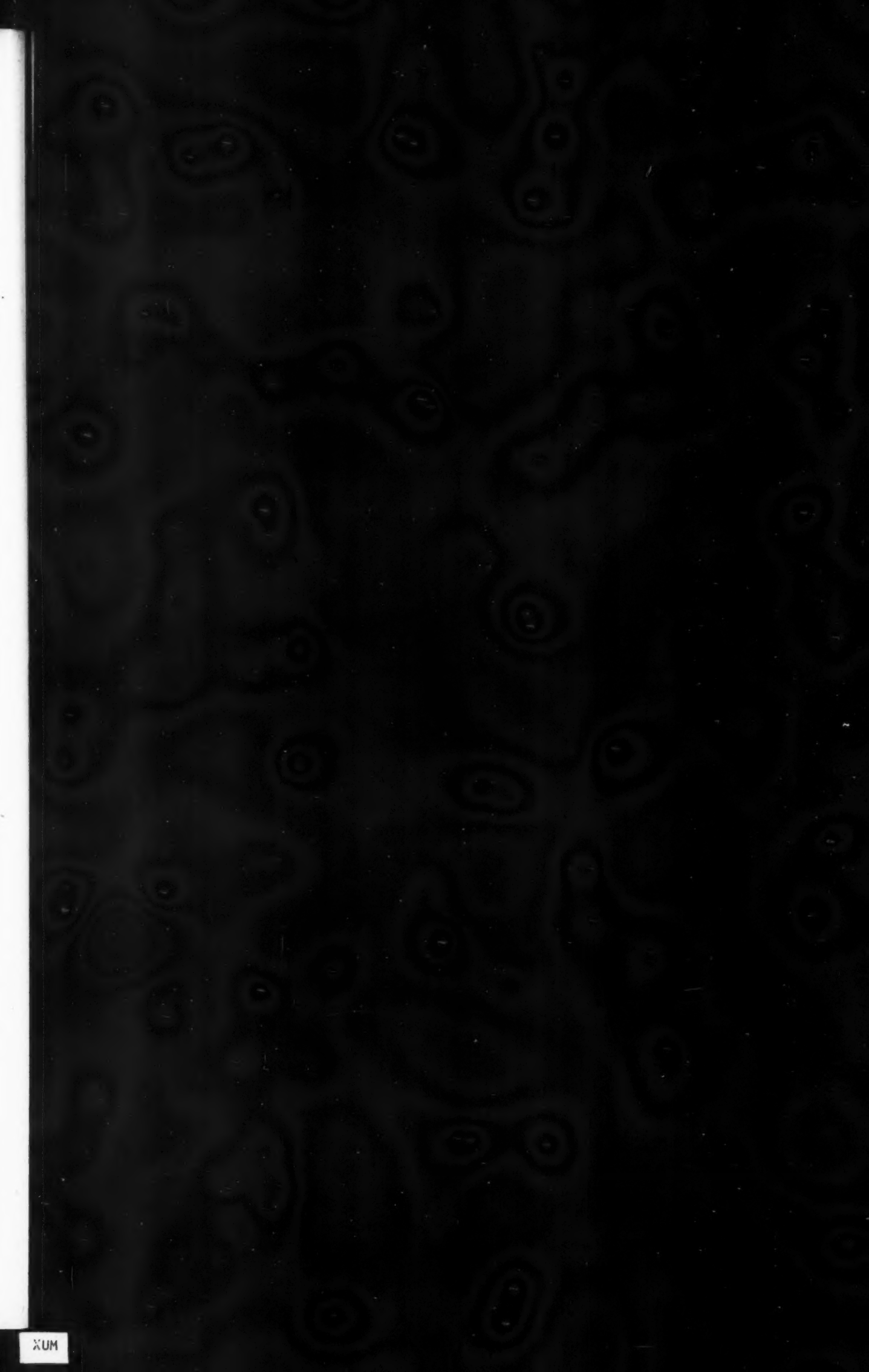

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